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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE MAKING OF A DARWIN[1]

I MAY take my text from a recent remark of Henry Fairfield Osborn to the effect that a Darwin could not be produced in the American university of to-day. This raises a number of questions, some of them unanswerable, but all of them worthy of the attention of scientific men interested in the continuance of a race of investigators.

As a starting point, I may quote Professor Osborn's words in full:

> If "the poet is born, not made," the man of science is surely both born and made. Rare as was Darwin's genius, it was not more rare than the wonderful succession of outward events which shaped his life. It was true in 1817, as to-day, that few teachers teach and few educators educate. It is true that those were the dull days of classical and mathematical drill. Yet look at the roster of Cambridge and see the men it produced. From Darwin's regular college work he may have gained but little, yet he was all the while enjoying an exceptional training. Step by step he was made a strong man by a mental guidance which is without parallel, by the precepts and example of his father, for whom he held the greatest reverence, by his reading the poetry of Shakspere, Wordsworth, Coleridge and Milton, and the scientific prose of Paley, Herschel and Humboldt, by the subtle scholarly influences of old Cambridge, by the scientific inspirations and advice of Henslow, by the masterful inductive influence of the geologist Lyell, and by the great nature panorama of the voyage of the *Beagle*.

The college mates of Darwin saw more truly than he himself what the old university was doing for him. Professor Poulton, of Oxford, believes that the kind of life which so favored Darwin's mind has largely disappeared in English universities, especially under the sharp sys-

[1] Retiring president's address before the American Association for the Advancement of Science, Minneapolis, Minn., December 27, 1910.

tem of competitive examinations. Yet this is still more truly the atmosphere of old Cambridge to-day than of any of our American institutions. It would be an interesting subject to debate whether we could nurture such a man; whether Darwin, were he entered at a Columbia, a Harvard or a Princeton, could develop mentally as Charles Darwin did at Cambridge in 1817. I believe that conditions for the favorable nurture of such a mind are not with us. They are repose, time for continuous thought, respect for the man of brains and of individuality, and of such peculiar tastes as Darwin displayed in his avidity for collecting beetles, freedom from mental convention, general sympathy for nature, and above all order in the world of ideas. If the genial mind can not find the kindred mind, it can not develop. Many American school and college men are laughed out of the finest promptings of their natures. In short, I believe our intellectual environment would be distinctly against a young Darwin of to-day.

These words of Osborn hint at certain weaknesses in our American educational system to which I shall refer later on. Meanwhile, I do not think that it is the whole truth, nor wholly the truth. If a Darwin were to be laughed out of his career, the event would have occurred in the English secondary school, where he was in fact nicknamed "Gas" on account of his interest in chemistry. And it is certainly not true that in the old Cambridge, or the new Cambridge, there is as high a valuation of unexpected originality as the suppositious young Darwin would find to-day in America.

I think that the elements which make up a Darwin can be reduced to three, whereof the first far overtops the others, the heredity of great genius being far more rare than one would infer from Osborn's words, and far more difficult to mar or discourage.

What, then, are the elements that we unite to make a great investigator, not of Darwin's class, let us say, for that comes only with many centuries, but a naturalist not unworthy to come in as a foot-note to a page on Darwinism? The fundamental elements, as I take it, are these three: First, the original material, to which we may look to heredity alone; second, meeting nature at first hand and meeting her early and persistently; third, the personal inspiration and enthusiasm derived from some great teacher. In Darwin's case, the raw material was of the highest order, the best which amphimixis ever put together. This material no university could spoil, though Cambridge and Edinburgh confessedly tried their best. Beetles, race-horses, flowers and trees, contact with nature—these kept up an enthusiasm promoted rather than checked by the hopeless dreariness of his university exercises. These gave the second element, and the third came from the privilege of the young Darwin to be "the man who walked with Henslow," and later with Sedgwick also.

In the American universities, heredity plays her part; her limitations, whatever they may be, are racial, and our stock is good. Nature is close at hand, closer than in the old world, and whosoever is really filled with zeal to know her has not far to go. Agassiz remained in America because in America he was nearer to his studies than he could be in Europe. Here "nature was rich, while tools and workmen were few and traditions none." All this our American universities offer in abundance. The final question is, then, that of personality, and the question I would raise is whether in accumulating tools and traditions even as in Europe, we are not failing in this regard. Are we not losing sight of the *man*, of the thing above all others which goes to the shaping of a great naturalist or a great scholar in any field? We may say that the machinery of our universities is developed not for the shaping of a Darwin, but for the moulding of very commonplace models. But so it is every-

where. Paulsen could never conceive that any of the great scholars of England should be professors in an English university. The work of the university, with its gowns and hoods, its convocations and degrees, its taking seriously the state-governed church and the hereditary aristocracy, seems so alien to the life of the great scholar that one can not conceive his taking part in them. And yet great scholars have done just this. They have developed in just this atmosphere, drinking from the real fountains of learning hidden within the university, and not from the drippings of the gargoyles with which medievalism has adorned its exterior.

In like fashion, we could not conceive of the young Darwin, in a claw-hammer coat in the afternoon defending his one major and two minors, with a thesis which no one will ever read, on a topic leading up a blind alley, as a doctor in any German university. But even this, or much worse or more incongruous, might happen to a Darwin or a Huxley, or a Lyell or a Gray, or a Helmholtz, an Agassiz or a Gegenbaur, were such to grow up into the universities of to-day. Externals count for little, and all these things are external. The man, the teacher and the contact with nature—these are the only realities. The beginning is in the man, his ability, his "fanaticism for veracity," and his persistence in the work. The university can not make the man. It can not wholly shut him away from objective truth, even if it tries desperately to do so, and its principal influence is found in the degree to which it grants the inspiration of personality.

The reading of good books can not be regarded as an element peculiar to any sort of university training. A good mind seeks good books and finds them. Shakspere, Coleridge and Lyell were just as accessible to me or to you as they were to Darwin. They are just as accessible to anybody anywhere. Time to read them is not even essential. One secret of greatness is to find time for everything in proportion to its worth to us. A further advantage is ours in this generation. We have the "Origin of Species" and the whole array of fructifying literature arising from this virile stem.

The only possible element in which the American university could fail is that of the influence of personality. Can it be that this influence is wanting? Do our men no longer "walk with Henslow," as once they walked with Gray and Silliman and Agassiz?

Do our men go to the university for the school's sake and not for the men who are in it? Is it true that as our universities grow in numbers and wealth, their force as personal centers or builders of schools of thought are declining? To some extent this is certainly true. Once when a young naturalist went in search of training and inspiration, he went to Agassiz. He did not go to Harvard. He scarcely thought of Harvard in this connection. Agassiz was the university, not Harvard. The botanist went to Gray. He did not go to Harvard. Later the chemist went to Remsen, the physiologist to Martin, the anatomist to Wall, the morphologist to Brooks. That these four men happened to be together at Johns Hopkins was only an incident. The student went out to find the man, and he would have followed this man around the world, if he had changed from one to another institution.

I saw the other day a paper of an irate German morphologist who in attacking a certain idea as to the origin of fishes' arms and ours, denounced "die ganze Gegenbaurische Schule," who followed Gegenbaur in his interpretation of this problem. Never mind the contention. The point is

that there is a Gegenbaur School of Morphology. This school was not the university, but Gegenbaur himself. We ought to have more such schools in America, schools of advanced thinkers gathered around a man they love, and from whose methods and enthusiasm the young men go away to be centers of like enthusiasm for others. I believe that our system of university fellowships is a powerful agency in breaking up this condition. If, by chance, it were possible for us to produce a Darwin, the raw material furnished, it would be a difficult task if a fellowship of $500 has drawn him to the laboratory of some lesser plodder, preventing him forever from being "the man that walked with Henslow." The fellowship system keeps our graduate courses running regardless of whether these courses have anything to give. So long as our fellows are hired to take degrees, then sent out to starve as instructors, so long will we find our output unworthy of our apparent advantages. And in our sober moments we will say with Osborn, we do not see how an American university could produce a Darwin. And at the same time, professors in universities in other lands will admit that the machinery for mediocrity offers little promise to the great. Jacques Loeb tells the story of a young man who applied through him for a fellowship in physiology at Chicago. His admiration for Loeb's wonderful genius as an experimenter and as an original worker on the borderland of life and matter led him to wish to work with Loeb above all other things. Loeb wrote back that he had resigned his chair in the University of Chicago to go to the University of California. Then, said the candidate, "will you kindly turn over my application for a fellowship to your successor at the University of Chicago?" This single case is typical of the attitude into which our fellowship system as it is now administered throws the young digs who arise in our various colleges. The embryo professor asks for his training not the man of genius who will make him over after his kind, but the university which will pay his expenses while he goes on to qualify for an instructor's position. By this and other means we are filling the ranks of our teaching force, not with enthusiasts either for teaching or for research, but with docile, mechanical men, who do their work fairly, but with few touches of the individuality without which no Darwins nor Darwinoids can ever be produced. It is a proverb at Harvard, I am told, that "the worm will turn, and he turns into a graduate student."

Thirty-eight years ago it was my fortune as a beginner in science to attend the meeting of this association at Dubuque. The very contact with men of science, which this meeting gave, was a wealth of inspiration. To hear these men speak, to touch their hands, to meet them on the street, to ride with them to the fossil-bearing rocks, or the flower-carpeted prairie, for the moment at least to be counted of their number, all these meant wonderful things.

Of these men, let me speak primarily of the students of natural history, for then, and even yet, I know little of anything else. They were naturalists "of the old school," these workers of the early seventies. Louis Agassiz, dean of them all, was not at Dubuque, but I came to know him very soon after. There was Asa Gray. I heard at Dubuque some Harvard man say, "There goes Asa Gray. If he should say black was white, I should see it looking whitish." There was Shaler, the many-sided, every side altogether charming; and Spencer F. Baird, the father of cooperative science, the science at the Capitol at Washington. There was Fred Putnam, the ever-present veteran, a veteran even in his

youth. There was Joe Le Conte, ever clear-headed and ever lovable. There was Newberry and Leslie and Gill and Allen and Swallow and Leidy and Calvin and Marsh and Coues, Wilder with his shark brains, and Scudder with his butterflies, and I know not what others, the great names of thirty years ago, names which we honor to-day. These men of the old school were lovers of nature. They knew nature, as a whole, rather than as a fragment or a succession of fragments. They were not made in Germany nor anywhere else, and their work was done because they loved it, because the impulse within would not let them do otherwise than work, and their training, partly their own, partly responsible to their source of inspiration, was made to fit their own purposes. If these men went to Germany, as many of them did, it was for inspiration, not for direction; not to sit through lectures, not to dig in some far-off corner of knowledge, not to stand through a doctor's examination in a dress coat with a major and two minors, not to be encouraged *magna cum laude* to undertake a scientific career. The career was fixed by heredity and early environment. Nothing could head them off and they took orders from no one as to what they should do, or what they should reach as conclusions. They did not work for a career—many of them found none—but for the love of work. They were filled with a rampant exuberant individuality which took them wherever they pleased to go. They followed no set fashions in biology. Such methods as they had were their own, wrought out by their own strength. They were dependent on neither libraries nor equipment, though they struggled for both. Not facilities for work, but endeavor to work, if need be without facilities, gave them strength, and their strength was as the strength of ten.

For this reason, each typical man of this sort had Darwin walking with him. He became the center of a school of natural history, a rallying point for younger men who sought from him, not his methods, nor his conclusions, but his zeal, his enthusiasm, his "fanaticism for veracity," his love for nature, using that hackneyed phrase in the sense in which men spoke it when the phrase was new.

Students of Agassiz, notably Scudder, Lyman, Shaler and Wilder, have told us what all this meant, where "the best friend that ever student had" was their living and moving teacher. The friendship implied in this, his worthiest epitaph, rested not on material aid, but on recognition of "the hunger and thirst that only the destitute student knows," the craving to know what really is, which outranks all other human cravings.

Marcou tells us the story of the wonderful work done in the little college of Neufchâtel, without money, materials or prestige, investigating, writing, printing, engraving, publishing, all in one busy hive at a thousand dollars a year, when the greatest of teachers had youth, enthusiasm, love of nature and love of man as his chief or only equipment. This story was repeated, with variations, at Cambridge, and with other variations by Agassiz's disciples throughout the length and breadth of America.

I heard Agassiz say once, "I lived for four years in Munich under Dr. Döllinger's roof and my scientific training goes back to him and to him alone." Later in America, he dedicated his contribution to the "memory of Ignatius Döllinger, who first taught me to trace the development of animals."

This suggests the thought of the heredity in science so characteristic of the old school. From Döllinger, Agassiz was descended.

From Agassiz, all of the naturalists of the old school of to-day, all the teachers and investigators who have reached the sixty-year mark or are soon to reach it. These men, from Joseph Le Conte and David A. Wells, of his first class, through Shaler, Wilder, Putnam, Alexander Agassiz, Hartt, Baird, Walcott, Whitman, Brooks, Snow, Lyman, Clark, William James, Faxon, Fewkes, Garman, down to Minot and myself, the two youngest of the lot, as I remember; Minot venerable already, according to the Boston press.

It is a characteristic of the men of the old school that they formed schools, that they were centers of attraction to the like-minded wherever these might be. There were no fellowships in those days whereby men are hired to work under men they do not care for and along lines which lead not to the truth they love, but to a degree and a career. We speak sometimes of the Agassiz school of naturalists, the Gray school of botanists, as in Germany "die ganze Gegenbaurische Schule" of anatomy, "die Haeckelsche Schule" of biology. These may be terms of praise or of opprobrium, according to the degree of one's sympathy with that school and its purposes.

To belong to a school in this sense is to share the inspiration of its leader. The Gray school of botanists no longer places the buttercup or the virgin's bower at the head of the list of plants, as a typical flower. Gray did this, but this is not an essential in honoring Gray. They begin at the bottom, Darwin-fashion, and the honor of the end of the list is given to the specialized asters and mints, or the still wider wandering orchids, the most eccentric, the most remotely modified, no longer to the typical, the conventionally simple. In this there is a tacit assumption that Gray would have done the same had he possessed the knowledge which is now the common property of his students. Probably he would, but that matters nothing, for each one follows his own individuality.

The characteristic of the Agassiz school was the early and utter discarding of the elaborate zoological philosophy which the master had built up. The school went over bodily to the side of Darwin, not because Darwin had convinced them by his arguments, but because their own work in whatever field led them to the same conclusions. No one who studied species in detail could look an animal in the face and believe in the theory of special creation. The same lesson came up from every hand, and we should not have been true to the doctrines of the master if we had refused faith to our own experience. When the Museum of Comparative Zoology was finished, Haeckel is reported to have said, perhaps in envy, perhaps in jest, that "the output of any scientific establishment is in inverse ratio to the completeness of its equipment." In other words, the more men have to do with the less they would do.

Statistics show that in this paradox there is at least a grain of truth, and this grain of truth stands at the base of my own misgivings. With the scantiest of equipment, much of our greatest work has been done. It is said that Joseph Leidy's array of microscopes and knives cost less than a hundred dollars. The "Poissons Fossiles" was written when its author lived from hand to mouth in the Latin Quarter of Paris, copying "on the backs of old letters and on odd scraps of paper the books he needed, but which he could not buy." Since Haeckel said the words I have quoted, and he tells me that I said them, facilities for biological work have multiplied a thousand fold. Every German university, Jena with the rest, and most American universities as well, have a far greater equipment than the Museum

of Comparative Anatomy had forty years ago. Victor Mayer is reported to have said that the equipment of every chemical laboratory should be burned once in ten years. This is necessary that the chemical investigator should be a free man, not hampered by his outgrown environment. In like vein, Eigenmann has said that when an investigator dies, all his material should be burned with him. These should be his creation, and he should create nothing which he can not use. These could be useful to none other, except as material for the history of science. Therefore, too much may be worse than too little. The struggle for the necessary is often the making of the investigator. If he gets what he wants without a struggle, he may not know what to do with it.

For facilities do not create. The men who have honored their universities owe very little to the facilities their universities have offered them. Men are born, not made. They are strengthened by endeavor, not by facilities. *Facilis descensus.* It is easy to slide in the direction of least resistance. That direction is not upward. It is easy to be swamped by material for work, or by the multiplicity of cares, or by the multiplication of opportunities. I may be pardoned for another personal allusion. I have spent the best portion of my life in the service of science, but for the most part not in direct service. I have tried to help others to opportunities I could not use myself. I have been glad to do this, because that which I might have done has been far more than balanced by the help I have been able to give to others.

But it is not clear that this greater help has led to greater achievement. I can not find that the output bears any direct relation to the means for producing it. The man who is born to zeal for experiment or observation can not be put down. He is always at it. Somewhere or somehow he will come to his own. No man ever adds much to the sum of human knowledge because the road is made easy for him. Leisure, salary, libraries, apparatus, problems, appreciation, none of these will make an investigator out of a man who is willing to be anything else. There is human nature among scientific men, and human nature is prone to follow the lines of least resistance. It takes originality, enthusiasm, abounding life, to turn any man from what is easily known to that which is knowable only through the sweat of the intellect. Of all the men I have tried to train in biology, those five I regard as ablest because of their contributions to science have been greatest, were brought up out of doors or within bare walls in which books, specimens and equipment were furnished from the scant salary. A struggling teacher, a very young teacher at that, at $1,800 per year, and ten per cent. of this for a biological library, is not a condition to attract advanced students to-day, but so far as my own experience has gone, I have never known stronger students than those who came to me to be trained under these pinching conditions. To-day these conditions are adjusted to the promotion of the docile student rather than the man of original force. He goes not to the man but the university. He finds work in biology, no longer a bit of green sod under the blue sky shut off by conventional and ugly hedges, and therefore to be acquired at any cost. It is a park, open on every side to anybody. Or, dropping the poor metaphor, he finds his favorite work not a single hard-won opportunity in a mass of required language and mathematics. He finds the university like a great hotel with a menu so varied that he is lost in the abundance. His favorite zoology or botany is not taught by a man. It is divided into a dozen branches

each taught by an instructor who is a cog-wheel in the machine. The master under whom he would seek inspiration is busy with the planning of additional cog wheels or the oiling of the machinery. Or, more often, there is no master teacher at all. The machinery is there and at his hand. He has but to touch the button and he has alcohol, formal, xylol or Canada balsam, whatever he needs for his present work. Every usable drug and every usable instrument is on tap; all we need, degrees and all, are made for us in Germany. Another button will bring him all the books of all the ages, all the records of past experience, carrying knowledge far ahead of his present requirements, usually beyond his possible acquirements. The touch of personality, the dash of heredity, is lost. Worse than all this, for the student who is worth while will orient himself even among the most elaborate appliances and the most varied concourse of elective, is the fact that he is set to acquire training without enthusiasm. Sooner or later he receives a fellowship in some institution which is not the one to which he wishes to go. Virtually, he finds himself hired to work in some particular place, not under the man of all men he has chosen to know. He is given some petty problem; it seems petty to him and to others. He takes this as his major, with two convenient minors, and at last he is turned out with his degree to find his own life if he can. His next experience is to starve, and he is not so well fitted for this as he would have been had he begun it sooner. If he finds himself among facilities for work, he will starve physically only. If he marries, he starves in good company, but more rapidly and under greater stress. If chance throws him into a college without facilities, he will starve mentally also. In any case, he will lament the fact that the university has given him so much material help, so little personal inspiration and at the end values its product so low, that with all the demands of scholarship and scholarly living his pay is less than that of the bricklayer or the hack driver. For he has attained a degree of scholarship without a corresponding degree of compelling force. His education has not given him mastery of men, because its direction has not been adequately his own. It is always the struggle which gives strength. Learning or polish may be gained in other ways, but without self-directed effort there is not much intellectual virility. Good pay, like some other good things, comes to the man who compels it. To make oneself indispensable, real, forceful, with a many-sided interest in men as well as in specialized learning is the remedy for low salaries. As college men we get all that we are worth on the average. Our fault is that we are in the average. We need more individuality.

In so far as the universities can remedy this, it would lie in the encouragement of men to take their advanced work in actual centers of inspiration. No one university has many such. Let the fellowships lead men to the few. Or let them be traveling fellowships available at the best centers of inspiration in this or any other country. Or, if the choice among departments be too delicate a matter for university officials to undertake, let the distribution of fellowships be confined to the men who already are on the ground. These men, in one way or another, have shown their confidence, have chosen their master. If the university wishes now to smooth their path to success, it would give pecuniary assistance without hiring them to go where they do not wish to go. There is no nobler ambition for a great investigator than to hope from a school of science to continue his own kind, by his own method, his own inspira-

tion, the contagion of his own love of knowledge. In no way can this be done save by letting like come to like, by opening the way from his own kind to find the way to their master. In this our present fellowship system is failing, and this failure is showing itself in the cheapening of virility and the cheapening of originality among our doctors of philosophy, as compared with our young workers of a generation ago.

An eminent teacher of physics said lately:

> The numbers of doctor's degrees in physics bear no relation to the eminence of the professors who grant them. They depend solely on the number of fellowships offered, on the number of assistantships available. In the institution which has conferred the greatest number in recent years, almost every one of these is drawn by the stipend offered; scarcely one by the unquestioned greatness of the leading professor.

The primary fault seems to be in our conception of research, which tends to point in the direction of pedantry rather than that of scholarship. Not all professors have this tendency; only those who are neither great scholars nor great teachers. It is, or ought to be, a maxim of education that advanced work in any subject has greater value to the student, as discipline or as information, than elementary work. Thoroughness and breadth of knowledge give strength of mind and better perspective. They give above all courage and enthusiasm. With each year, up to a certain point, our universities carry their studies further toward these ends, and the student responds to each demand made on his intelligence and his enthusiasm.

Then research begins, and here the teacher, as a matter of duty, transforms himself into the pedant. Instead of a closer contact with nature and her problems, the student is side-tracked into some corner in which numerical exactness is possible, even though no possible truth can be drawn from the multiplicity of facts which may be gathered.

This sort of research, recently satirized by Professor Grant Showerman, in the *Atlantic Monthly,* is not advanced work at all. It may be most elementary. The student of the grammar school can count the pebbles in a gravel bank to see what percentage of them lie with the longest axis horizontal as easily as the master can do it. That is not research in geology, however great the pains which may be taken to ensure accuracy. The student may learn something. All contact with gravel teaches something of the nature of rocks, as all reading of Plautus teaches something of poetry; all contact with realities gives some reality as a result. Yet there is no result involved in the case above indicated, in the investigation itself. We know that if flat stones are free to fall, the longest axis will approach horizontality, and that is the end of the matter.

Mr. Showerman's suggested comparison of the "prefixes in P. to be found in Plautus," "the terminations in T. of Terence" and "the sundry suffixes in S.," is scarcely an exaggeration of the kind of work assigned to many of our research students. Such work is in itself absolutely elementary. It teaches patience and perhaps exactness, although, where the student finds that error is just as good as truth in the final round-up, he is likely to lose some of "the fanaticism for veracity" which is the central element in the zealous comradery of the extension of human knowledge. So long as the "new work" on which our doctors of philosophy address themselves is found in material rejected by scholars because a study of it can not possibly lead anywhere, so long will these doctors be neither teachers nor enthusiasts. They will justify the clever sneer as to the turn-

ing worm and the graduate student. Elementary facts about raw material are not the advancement of knowledge. They are killing to those who have a capacity for something better. The listing of "Terence's terminations in T." is a type of work which at the best bears the same relation to research that forge-work bears to engineering. It is worth while to the engineer to know what it is like and to be able to handle a hammer if need be. Moreover, a hammered-out horse-shoe is an actual reality. But to make a horse-shoe, even one of a form never seen before, is not the final thesis for which the engineer enters the university.

Much of the graduate work in non-mathematical subjects receives an appearance of accuracy from the use of statistics, or other forms of mathematics. This seems to make the results "scientific." Mathematics is a science only when its subject-matter is science—when it deals with results of human experience. At other times, it is simply a method—a form of logic. A mathematical enumeration, or even a formula, does not give exactness where it did not exist before.

The statistical enumeration of the "prefixes in P.," or the pebbles in the bank, is held to give the method of research. It teaches patience and accuracy, two fundamental virtues in the progress of science. Patience, perhaps, if the student persists to the bitter end. Accuracy certainly not. Sooner or later the student will discover that to multiply by ten one of his columns of figures or to divide another by five will have no effect on his final conclusion, for there isn't going to be any conclusion. He will then learn to supplement his tables by the quicker and more satisfactory method of guess work. He turns from the methods of pedantry to the method of journalism. At the best, he will find that the less laborious methods known as qualitative have the advantage over quantitative methods, where matters of quantity have no real significance.

No one should begrudge any amount of time or strength or patience spent on a real problem. In that regard, Darwin's attitude towards the greatest of biological problems is a model for all time. But we should believe that there is a problem, and that our facts point towards the truth in regard to it. A fact alone is not a truth, and ten thousand facts may be of no more importance. A horse-shoe is not an achievement. Still less are ten thousand horse-shoes. "Facts are stupid things," Agassiz used to say, "unless brought into connection by some general law." In other words, facts signify nothing, except as the raw material of truth.

A graduate student of an honored philologist in a great university lately explained her graduate work to me. A chapter in Luther's bible was assigned to her, another to each of her fellows. This was copied in longhand, and after it, all the variant German versions of the same chapter. Her work was to indicate all the differences involved. There may have been something behind it all. The professor may have had in mind a great law of variance, a Lautverschiebung or Entwickelung of pious phraseology. But no glimpse of this law ever came to the student. More likely, the professor was at his wits' end to find some task in German which had never been accomplished before, and which had never before occurred to any German taskmaster. No wonder the doctor's degree is no guarantee of skill as a teacher! Among the first essentials of a teacher are clearness of vision and enthusiasm for the work. This is not cultivated by these methods. It is not even "made in Germany." The "law of time relations of iron and sul-

phuric acid" may be developed in a year's work by dropping a thousand weighed shingle nails into a thousand test-tubes of sulphuric acid, each having the amount requisite to turn the whole into an iron sulphate. The length of the period before each shingle nail disappears and that before the resultant liquid becomes clear can be measured. It may even be proved that the cleaner the nail, the more quickly it dissolves. But all this is not chemical research. It gives no wider grasp on the marvelous processes of chemical reaction, and no greater enthusiasm for chemical work, nor grasp on chemical teaching.

If the counting in Plautus of the prefixes in P. is a type of the only sort of research that the classical knowledges permit, then let them go without research. Let them fall back on the charms of Latin verse, the surprises of Latin wit, the matchless power of description of which the Greek language is capable, and the monumental splendor of the oldest of the storytellers, who brought even the gods into his service. Let literature be literature, and science science, and enthusiasm will precede and follow any real advance in knowledge. Let the student be free to learn and not to grind. Let him go with the masters of his own free will, not as he is hired by the pedants. As a final result, we shall have again schools of thought and action in America, and the doctor's degree will not be a hindrance in the profession of university teaching.

When our graduate work is really advanced work, under men who know the universe in the large as well as in the small, its great movements as well as its forgotten dust heaps, we shall have our American schools of science, and the Darwins will again "walk with Henslow," over fields as green as were ever those of Cambridgeshire.

With the failure of the enthusiasm of the teacher, we have a lowering of ideals on the part of students. They come too often to look for science as a career rather than as an opportunity to do that which in all the world they would rather do, that which they would die rather than leave undone. Too often, in the words of John Cassin, "they look upon science as a milk cow rather than as a transcendent goddess."

The advent of the elective system, thirty years ago, bore a wonderful fruitage. Men, soul-weary of drill, turned to inspiration. Teachers who loved their work were met by students who loved it. The students of science thirty years ago came to it to escape from Latin and calculus with the eagerness of colts brought from the barn to a spring pasture. In regions of eternal spring, these colts do not show this vernal eagerness. Now that science is as much a matter of course as anything else, there is not this feeling of release; and the feeling that one to whom the secrets of the woods and hills, the story of the sea and the rocks, have been made known, belongs to a chosen class, disappears when these matters are made open to every one. Scientific knowledge as the result of continued endeavor and of persistent longing is more appreciated than when it comes as an open elective to all who have completed English 3 and Mathematics 5.

In one of the poems of James Whitcomb Riley, this sentence is expressed:

Let's go a visiting back to Grigsby's Station,
Back where we used to live, so happy and so poor.

"So happy and so poor" the American college once was, that the student, the teacher and nature were all together, all hand in hand. It was this which made at Munich the "Little Academy" concerning which Agassiz once spoke so eloquently. It was the contrast with greatness in the most simple surroundings that gave the

school at Penikese its unique position. As to this school, I once used these words:

> With all appreciation of the rich streams which in late years have come to us from many sources, and especially from the deep insight and resolute truthfulness of Germany, it is still true "that the school of all schools which has most influence on scientific teaching in America" was held in an old barn on an uninhabited island some eighteen miles from the shore. It lasted for three months, and in effect it had but one teacher. The school at Penikese existed in the personal presence of Agassiz; when he died, it vanished.

Contact with great minds is not so common to-day as it was when the men of the old school were the leaders of the new. The enthusiasm of struggle, the flash of originality, grows more rare as our educational machinery becomes more perfect. If our present system fails, it is in the lack of personal contact and personal inspiration. If we can not create new Darwins, the raw material being found, it is because they can not walk with Henslow. Henslow is somewhere else, perchance in some government bureau of science, or if he is present he has too much on his mind to be a good walker. We do not value him enough to make him free.

We have too much university in America, and too much of what we have in a boy's school. The university as such is a minor affair, an exotic attachment. Should a great teacher, a real man of God, of the god of things as they are, arise in the faculty, he becomes a department executive. More than half his students are of gymnasium grade, and nine tenths of his teaching is done by young men, men who have not made their mark or who have made it only as cog wheels in the machine. Too often these are caught in the grind and are never able to show what they might have been if their struggles had been towards higher ends. Smith teaching zoology 10; Brown, botany 7, and Robinson, geology 3, can not lead their students or themselves to look on nature in the large or to see the wonderful vistas beheld by a Lyell or a Humboldt. The university in America is smothered by the college. The college has lost its refinement of purpose through coalition with the university. The two are telescoped together to the disadvantage of both. The boy has the freedom and the facility of the university when he can make no use of it. The university man is entangled in the meshes of the college. University facilities we have enough for ten times—twenty times—the number of students. We go into the market to hire young men to avail themselves of them. There is no corresponding emphasis laid upon men, and men of the first rank are no more numerous to-day than they were in the days of Agassiz, Lowell, Longfellow, Gray, Holmes, Dana, Silliman, Gibbs, Leidy, Goodwin, Angell, White and Goldwin Smith. It is the man who makes the school, and who completes the chain of heredity from the masters of the last century in Europe to the masters of the twentieth century in America. Excellent as our facilities are, complete as are our libraries, our laboratories and our apparatus, easy as is our access to all this, we have only made a beginning. Another ten years will see it all doubled. What we have is far from complete. But the pity of it is, our students will not guess its incompleteness. Half as much or ten times as much, it is the same to them as the doubling of the bill of fare at the Waldorf-Astoria would be unnoticed by the guests. A still greater pity is this, even the teachers will not know the difference. They can use only what they have time and strength for. The output is no greater for the helps we give. The greatest teacher is one who is ruler even over his books, and who is not smothered by them.

Enthusiasm is cultivated by singleness of purpose, and in our system we make provisions to distract rather than to intensify. There is a learned society, to which many of us belong, Sigma Xi. Its value depends on its ability to make good its motto, Spoudon Xynones, "Comrades in Zeal." We whistle to keep up our courage in the multitude, not of dangers, but of distractions, and if we whistle in unison we may keep step together. This society in a cooperative way, the same spirit in different places, stands for enthusiasm in science. Now enthusiasm comes from struggle, from the continuous effort to do what you want to do, and for the most part in the way you want to do it. Hence, comradery in zeal should make for individuality, for originality.

The most serious indictment of the new school in science is its lack of originality. Even its novelties are not original. They are old fabrications worked over, with a touch of oddity in the working. The requirements for the doctor's degree tend to curb originality. But these do not go far. A man may be original and even in a dress coat in the daytime may be rated as *summa cum lauda*. The greatest foe of originality is timeliness. Rather, timeliness is evidence of lack of originality, of lack of individual enthusiasm.

When a discovery is made in botany, the young botanists are drawn to it as herrings to a search light, as moths to a lantern. In Dr. Coulter's words, "they all dabble in the same pool." Not long since the pool was located in morphology; then it was in embryology; then in the fields of mutative variations; now it is filled with unit characters and pedigreed cultures.

I would not underrate any of these lines of work, nor any other, but I respect a man the less when I see him leaving his own field to plunge into one which is merely timely, into one in which discovery seems to be easy, and the outlook to a career to be facilitated.

All honor to the man who holds to his first love in science, whatever that may be, and who records his gains unflinchingly, though not another man on earth may notice what he is doing. Sooner or later the world of science returns to every piece of honest work. The revival of the forgotten experiments of the priest Mendel will illustrate this in passing. Hundreds of men are Mendelians now, who would never have thought of planting a pea or breeding a guinea pig had not Mendel given the clue to problems connected with these things.

The man of to-day, busied with many cares, looms up smaller than the man of the old school who walked with Henslow and then walked with nature. In this thought, it is easy to depreciate our educational present.

Homer, referring to the Greeks of earlier times, assures us, "There are no such men in our degenerate days." I have never verified this quotation—the men of our days are too busy to verify anything—but we may take the sentiment as characteristic. From the days of Homer till our own time, the man of the old school has always found the times out of joint. Perhaps, in getting so elaborately ready, we are preparing for a still more brilliant future. It may be that books, apparatus, material, administration and training are all worth their weight in men, and that modern educational opportunities are as much better than old ones as on the surface they seem to be. I know that all these misgivings of mine represent no final failure. Each generation has such doubts, and doubts which extend in every direction. The new strength of the new genera-

tion solves its own problems. The new men of the new schools of science will master the problems of abundance and of distraction even as ours solved the problem of hostility and of neglect. The man is superior to the environment, and the man of science will do the work he loves for the love of it. In this love he will develop the abundance of life in others as in himself, and this is the highest end of all our striving.

The atmosphere of a great teacher raises lesser men to his standard. It perpetuates the breed. It was not books nor apparatus that made Döllinger or Agassiz or Brooks successively centers, each of a school of research. It was the contagion of devotion, the joy of getting at the heart of things, the love of nature, the love of truth. Sometimes, in our wealth of educational opportunity, we long for the time when, as of old, the student had the master all to himself, the master unperplexed by duties of administration not called hither and thither by the duties of his station, but giving himself, his enthusiasm, his zeal and his individuality, to the student, not teaching books, but how to make books our servants, all this time master and student struggling together to make both ends meet and sometimes succeeding, "so happy and so poor." So it was in the old time, and so it shall be again when the new demands and the new wealth find their adjustment. And to find this we shall not go back to Grigsby's Station, nor yet to Penikese; for the scholars that are to be shall rebuild the American universities in their own way, as the scholars of to-day are restoring the University of Cambridge, and in a greater or less degree all other universities in all other lands where men know and love the truth.

David Starr Jordan

AN EXPERIMENT IN MEDICAL PEDAGOGY[1]

You may be surprised to know that I am very thoroughly aware of a certain measure of unpopularity I possess as a teacher of pathology. The condition long ago acquired definite features of chronicity. I know too that a certain apprehension in some instances has been the chief impelling force for the thorough work students have done with me. It may also surprise you to learn that the realization of these conditions has never been especially pleasing.

In view of my considerable tenure of office in this institution, now eighteen years, it would seem as though some explanation for this state of affairs was about due and I have been impressed with the notion that an attempt to make one might at least entertain you for the period usually allotted to this part of the program. I prefer that you decide whether the explanation I am about to undertake of this unpopularity is an apology or a defense.

There is no doubt that some of this opprobrium which in common with most teachers has been my portion is due to curiosity of mine as to the facts possessed by students in regard to matters pathological and their ability to use them, a curiosity so overwhelming as to consume most of the time in the courses assigned me and to leave but little for the imparting of new or additional information. To ascertain the student's equipment with knowledge which has a real dynamic value and represents power rather than learning in the usual sense has always been a fascinating inquiry for me. To illustrate this some recent experiences using museum preparations for teaching purposes will serve. We have used such preparations in a routine way for a number of years in the patho-

[1] An address before the class graduating at the end of the winter quarter, 1910.

logical department. During the first six months of this period I demonstrated these specimens to small groups of students. Then I discovered that what the student saw in the preparation was for the most part seen in a mimicry way and because the particular features were pointed out. Without inquiring, I had no assurance that those important features were seen or understood, notwithstanding my demonstration. Since then the labeled museum specimens have been demonstrated by the students to the instructing force and the student searches independently for the alterations illustrated by the preparation. What he fails to recognize among the important characteristics can be pointed out just as well by this plan as the other and certainly his attitude in the examination of the museum preparations has been changed. We are all prone at times to forget and pay so much attention to teaching that no opportunity remains for the exercise of such indiscrete curiosity referred to as being a handicapping possession. The result of this is that the one teaching has no proper appreciation of what the student is learning or has learned and when occasion demands that in some way the student shall show what he or she has gained, amazement on the part of the instructor and sometimes other feelings result from seeing how little of real value has been conferred.

Other factors which have discouraged enthusiasm over your present speaker's methods of instruction are, the great demand for carefully systematized information suitable for written examinations and my reluctance to furnish such didactic instruction. Although I recognize the necessity you are all under of passing examinations (most of them written examinations) during your undergraduate work, for graduation, for hospital positions and for licensure, necessities which I regret and do not believe should exist as now constituted, I have found it very difficult to become deeply interested in any examination which is not a practical test of efficiency. I am unwilling to accept what a student writes in an examination as an equivalent for what he or she can do when confronted with the conditions discussed in written answers. This view is only a detail of a larger belief and ideal which I am confident we have in common, that a medical school should be a place where medicine is practised by students instead of a place where students prepare to practise; and in subscribing to this as a worthy ideal you in all justice will admit that an absence of enthusiasm on my part over your preparation for written examinations is not entirely inconsistent and you will perceive the reasons for my interest and activity in actual work by the student rather than in didactic instruction.

The statement just made that a medical school should be a place where students practise medicine sounds a little trite, but the discussions of this truth in one way and another in recent years have formed in this country the nucleus for a literature on medical education where little of the sort previously existed. We are all, student body and faculty, keenly alive to the great need of this school for a hospital in which to teach medicine.

You no doubt know of the activity awakened among the state boards of examiners for licensure by the council of medical education of the American Medical Association, the chairmanship of which we are honored by having Professor Bevan occupy. One of the results to which this activity has in some measure contributed is the introduction by the medical board of Minnesota of practical examinations for the license to practise medicine in that

state—practical examinations already carried out in some branches and to be extended to all branches very shortly according to their statements. Furthermore, that board has notified other state boards that full reciprocity relations would be held only with such state boards where similar methods of examination were in vogue. When I heard this announcement made I thought that the millennium was certainly approaching, for I too, like some others among teachers, have fondly and hopefully talked and thought of the correction of perverted view-points and other existing evils which such methods of testing your efficiency would bring about.

To some of my colleagues my reluctance to teach didactically may seem a dereliction of duty, but this remissness apparently is not productive of such lamentable results as at first glance one might suppose would be the case. The facts needed by our students to pass examinations in pathology are obtained in some way and acquired very well to judge by the reports. In one of the western states where it is believed the medical board has always favored graduates from institutions in that state, one of our graduates took the examination for a license to practise not long ago and subsequently told me that one of the medical examiners in complimenting him upon his success referred to the high grade secured in pathology by graduates from this school. Evidence is at hand from other sources that students here do in some way obtain the necessary information in pathology for such ordeals notwithstanding this lack of didactic instruction.

There is another phase of this subject which I am disposed to treat frankly with you. I know you already have strong suspicions of the existence of a difference of opinion among many of your teachers here in regard to the work of the so-called hospital class,[2] the advisability of its continuance and of faculty recognition for it. It does not seem to me imprudent to tell you that the consideration of this matter at faculty meetings has developed sharp differences of opinion. It is altogether complimentary to your faculty that questions of teaching methods and their merits can excite such—to state it mildly—enthusiasm. I am also disposed to discuss this subject because I have occupied places in both camps. One of the reasons of my desertion to the camp of those who are strongly opposed to this method of teaching may seem a strange one to you. It is the well-founded conviction I possess that teaching in medicine which has for its chief and final aim, the diagnosis of the disease, is pernicious because it tends to generate a sense of contentment and triumph over the arrival at a diagnosis, because it appoints as the journey's end what should be but a breathing place, because there goes with this emphasis of investigation to predicate a diagnosis, the implication, at least, that with the diagnosis made, investigation can cease and treatment begin; and I have been convinced that the work of the so-called hospital class—and you will please remember that I labored faithfully in this kind of teaching a number of years—is of such a character as to cultivate in the minds of the students the notion that accurate diagnosis represents the Ultima Thule of their inquiries, the finality of medical education. This conviction is partly the result of watching the careers of students who have industriously followed the hospital class work, practised

[2] A class prepared by written and oral so-called "quizzes" for hospital examinations, particularly for the written examinations conducted under the civil service regulations which govern the securing of places as residents in Cook County Hospital, the large charity hospital of Chicago. The system of preparation is essentially one of "cramming."

diagnosis and treatment in their hospital services, studied diagnosis in many courses in Europe and have never been able, apparently, to obtain any other view-point of medicine by reason of these deadening influences at an impressionable age. In some instances the results have been but little short of a tragedy.

When in the course of events I became converted to this view, although firmly believing in a hospital training and in the large field legitimately occupied by diagnosis in medical education, I could not consistently help students to secure hospital positions by a course of instruction which I believed was by its very nature disposed to bring about their practise of medicine in hospital work as though it was a finished science. The problem thus presented itself to me very clearly. Should I devote my time to instilling in the minds of students the unfinished or the completed condition of medicine? So I became an anarchist in so far as my energies have been concerned in destroying what in other ways was being built up. The disapproval of a considerable number among the student body was immediately my portion when I took this step.

In passing from this to another phase of these matters it is proper to remark that the field of my labors, having to do considerably with the examination of dead bodies, is not one which helps to give the worker in such a field a fair and just estimate of the heights to which diagnosis in medicine has actually attained.

You may be interested and perhaps a little chagrined to know that in your instruction in pathology during the last two years of your medical course, you have played the rôle of apparatus in a pedagogical experiment, an experiment which has been going on now almost nine years. I have already pointed out that our graduates in spite of the absence of any considerable didactic instruction in pathology during the last two years in medicine pass the state board examinations; as you know, the percentage of failures is commendably small. The large number of graduates from this school who secure hospital positions by written examinations do so without participation by members of the pathological department in the instruction of the class preparing for such examinations. These conditions, however, had nothing to do with the initiation of the pedagogical experiment I wish to describe.

The teaching of pathology has, to my knowledge, no fixed or standard method. In each medical school or university methods are in vogue which are largely matters of tradition. There is no widely endorsed plan nor is there any organization among pathologists for the purpose of ascertaining and adopting the most desirable method of teaching this branch of medicine analogous to the associations of other professional teachers, for example the National Society for the Promotion of Engineering Education, in this country. Perhaps the nearest approach to any concerted effort of this sort has to do with the recommendations of the council of medical education previously referred to which deal with the apportionment of the time to be spent in the different studies. It has been left to each instructor to follow his own methods and ideas. In most institutions following the acquirement of the principles of general pathology and bacteriology students are expected to obtain with more or less thoroughness a knowledge of the subjects usually included in the textbook considerations of special pathology or regional morbid anatomy, a systematic review of the lesions of particular tissues or organs.

There were several reasons for abandon-

ing the latter part of this traditional method when the instruction during the first two years was transferred to the university in 1901. One was the lack of time in the crowded schedule of the last two years of medicine; another, that in all the other branches taught in the last two years there is of necessity a great deal of attention paid to the details of these regional lesions. The weightiest reason was the necessity, had traditional customs been followed, of making the instruction largely didactic.

As students you are familiar with Course VI.–12.[3] You know the large part your labors have played in the completion of the records of post-mortem examinations. Since the summer of 1901 when this course was begun, and beginning gradually, the records of over 1,000 post-mortem examinations have been completed in the regular class work. As now conducted students perform all of this work under supervision and during the last year or two some of the student assistants have acquired sufficient proficiency to be entrusted with the post-mortem examinations. The work of the class has been mainly the histological and bacteriological examinations. I have not attempted to estimate how many isolated anatomical examples of disease from operations and sources other than the post-mortem examinations included in our regular series have been examined by students in this course; their number would be a considerable one, certainly several hundred. A great deal of material such as drifts into every pathological laboratory has not been utilized in this manner because of its poor teaching value; it has been insufficient in amount, the clinical facts have been meager and the aim has been to do more than simply diagnose the lesion.

Eight hundred and thirty-three students have taken the course which has now been running 33 quarters[4] not counting the one just completed. The average number of students per quarter has been 25¼, the average number of post-mortem examinations attended by each class, as a whole, 16⅝, altogether 548 during the nine years, about half of the number added to the files of the laboratory during that time. The remaining half of the post-mortem examinations were attended very largely by portions of the class, sometimes a few, sometimes nearly the entire class. All of the important organs are usually brought to the laboratory, those with the important lesions always when possible. There are many other details of the work of this class interesting from the standpoint of teaching, but time requires me to limit myself to the more important results. In connection with the work students have made 450 reports to the class. Some of these reports have been but a few brief remarks in connection with a demonstration of microscopic preparations, gross lesions or the results of bacteriological examinations. On the other hand, a small portion of the reports or the work in connection with them have resulted in published accounts. In the *Transactions of the Chicago Pathological Society* there are between fifty and sixty articles contributed by *undergraduates* of this school; many of these are the result of work begun in this class. Others, as you know, have resulted from special work under the direction of

[3] This course in pathology is taken by students during the last two years of medicine and Rush Medical College is no exception to other medical schools located in large cities; many students with part of their training in the universities of smaller places complete their medical studies where the clinical material is more abundant.

[4] The quarterly system, four periods of ten to eleven weeks each year, is used at Rush Medical College.

other teachers in this department, Drs. Hektoen, Weaver, Wells, Ricketts, Jordan and Harris. Many others have resulted from the completion of some work in the class which broke the ice, so to speak, and taught the students facility in investigation and productivity. For some few these first efforts were the beginning of periods of investigation not yet ended and we all have been proud of both the products and the producers.

Now as to the value of this experiment in medical instruction, I am confident the results are such that its continuance is advisable. Pedagogical problems are as worthy of experiment as any, and in this country especially the investigation of teaching methods has been active, although not so much in medicine perhaps as in other sciences. In an address before the American Federation of Teachers of the Mathematical and Natural Sciences in 1908, Professor Remsen stated that he had been experimenting to find out how to teach chemistry and that it was the most difficult experiment he had ever tried. I have no doubt his experimentation has been going on many more years than the one I am interested in. I can not refrain from comparing the work of Course VI.–12 to that of some of the technology schools which have won commendation by teaching and producing articles of commercial value at the same time. The records of the post-mortem examinations are certainly of some value as a product.

In discussing the results of the teaching as carried out in this course, reference may be made again to some of the ideas expressed earlier. I feel obliged to caution any one who will undertake to apply to his or her teaching the methods we have endeavored to carry out in the class work of Course VI.–12, for I fear they incur great danger of losing whatever of proper regard they may have for didactic instruction. I do not believe it is altogether the more lucrative rewards surgery offers as compared with other varieties of medical practise which is responsible for a complaint often heard about internes, "that all they seem to care about is to see cutting and blood run"; certainly the teaching of surgery to undergraduates offers many problems; their opportunities to participate in the surgical work in hospitals had many novel experiences for them. The Course VI.–12 offers excellent opportunity for the student to become acquainted in a practical way with the incomplete state of medical science and what to my mind is an especial advantage, with the limitations of medical diagnosis; and these things are learned not by the telling but by the doing. On all sides we hear at present of the value of investigation in maintaining a critical attitude; we might well ask, when has experience failed to lead to wisdom in intelligent beings?

In the course under discussion it has seemed to me that the greatest good is represented by the reports made by students (450 to 833 students, a little over one half), for these represent the result of personal, and, as far as possible, independent study.

And here is the crux of the entire matter of my unpopularity; it lies in my effort to make individual inquiry as independent as possible, to help only at the last moment, and since this means to so many students a predicament they are unaccustomed to, my motives no doubt have been misunderstood in many instances, the value of the method questioned or condemned in others. In conclusion, if you are in doubt as to whether this has been an apology or a defense, I beg you to overlook the introduction of the personal element of my unpopularity, a matter in which I never was greatly in-

terested, and remember the advice given you in making your reports to the class, never to read them. I would like now to add to that advice the recommendation that when you do read a report, as I have this, you introduce into it something guaranteed to prevent drowsiness on the part of your audience.

E. R. Le Count

Rush Medical College, affiliated with the University of Chicago

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NOTES RELATIVE TO THE INVENTORS GUILD

In the early part of 1910, several men who had done work along the line of invention, and who, in developing and patenting their inventions, had come to realize the difficulties and disadvantages under which the inventor labors, instituted a movement for the formation of a society looking toward the betterment of these conditions. The result of this movement was the formation and incorporation in New York City of the Inventors Guild, the object of which is briefly outlined in the following quotation from the Constitution of the society:

> The object of the Guild is to advance the application of the useful arts and sciences, to further the interests and secure full acknowledgment and protection for the rights of inventors, to foster social relations among those who have made notable advances in the application of the useful arts and sciences.

Some of the handicaps to which the inventor is subject, other than the proverbial one of never having any money, are the delays in the Patent Office and the ineffectiveness of its work, due to over-crowding and lack of proper facilities; the expense and tardiness of litigation, and the possibility under which a rich corporation may, by delaying and prolonging a suit, increase the expenses to a point which makes such suits prohibitive for a poor inventor; the disadvantage to which the American inventor is subject in foreign patent offices, as compared with the liberality of the American Patent Office toward the foreign inventor; and many other conditions militating against the American inventor which should be remedied.

The membership of the Inventors Guild is limited to fifty. The idea of limiting the membership is that with a small society of this sort it is easier to accomplish real results than with a larger organization, hampered as it must be by unwieldiness and red tape. Further, with a small organization each man will feel that he is a working unit, and that he will be depended upon to do real work, whereas in a large organization the general feeling is that there will be plenty of other men to do the work, and that lack of assistance from any particular member will make little, if any, difference. The result is that in the large organization the work, if any, is usually done by even a smaller number of members than that provided for in the Inventors guild.

It is proposed to select the membership of the guild carefully, and to this end a member must be formally proposed by a member of the guild, must be personally known to five members of the guild, must pass the membership committee and board of governors, and finally must be voted upon by the whole membership, four per cent. of the votes cast being sufficient to reject a candidate. The object of such discrimination is to include amongst the members of the guild men who not only have made inventions, but who have achieved some measure of success therewith, and who will therefore be capable of exerting some influence; and also that no one shall be admitted who will not be congenial to practically the entire membership.

The officers of the Inventors Guild are as follows: *President,* Ralph D. Mershon; *First Vice-president,* Chas. W. Hunt; *Second Vice-president,* Chas. S. Bradley; *Secretary,* Thomas Robins; *Treasurer,* Henry L. Doherty.

The Board of Governors are: Ralph D. Mershon, Leo H. Baekeland, Chas. W. Hunt, Chas. S. Bradley, Michael I. Pupin, Peter Cooper Hewitt.

The Professional Committee are: F. L. O. Wadsworth, *Chairman;* Thomas A. Edison, Chas. S. Bradley, Peter Cooper Hewitt, Michael I. Pupin, Bion J. Arnold.

At the present time the guild has twenty-nine members, as follows: Bion J. Arnold, Dr. L. H. Baekeland, W. H. Blauvelt, Chas. S. Bradley, Alex. E. Brown, Henry L. Doherty, Thomas A. Edison, Carleton Ellis, Stephen D. Field, James Gayley, Edward R. Hewitt, Peter Cooper Hewitt, Chas. W. Hunt, Dr. John F. Kelly, T. S. C. Lowe, Ralph D. Mershon, Ambrose Monell, Professor Edwin F. Northrup, Professor G. W. Pierce, Chas. E. Pope, Professor Michael I. Pupin, Thomas Robins, Dr. F. Schniewind, C. H. Smoot, Professor Carl Thomas, F. L. O. Wadsworth, Arthur West, Dr. W. E. Winship, B. F. Wood.

THE NATIONAL GEOGRAPHIC SOCIETY

BELOW is given the program of the popular meetings of the National Geographic Society for 1910–11.

The program of lectures can be followed until after January 13. There will probably be several shiftings of the lectures in order to meet the convenience of the speakers. All lectures begin at 8.15 promptly.

November 18: "Wild Man and Wild Beast in Africa." By Colonel Theodore Roosevelt. This lecture will be in Convention Hall.

November 25: "A Glimpse of Portugal." By Miss Laura Bell. Miss Bell was in Portugal for several months during the past summer, and has had an exceptional opportunity to understand the people and conditions of this picturesque country. Illustrated.

December 2: "Four Journeys of a Naturalist in the Islands of the South Pacific." By Henry E. Crampton, Ph.D., of the American Museum of Natural History. Dr. Crampton will tell of his travels in the Society, Cook, Tonga, Samoan and Hawaiian Islands, and in New Zealand. The natives, their every-day lives and ceremonies, the active volcanoes of Samoa and Hawaii and the free life of the Pacific will be described. Illustrated.

December 9: "My Friends, the Indians." By Mr. Frederic Monsen. Illustrated with color-graphs and motion pictures. Mr. Monsen for years has been studying the Indians of Arizona and New Mexico, and his series of pictures of Indian life and manners are as beautiful as they are instructive.

December 16: "The Glories, Sorrows and Hopes of Ireland." By Mr. Seumas MacManus, author of "A Lad of the O'Friel's," "Through the Turf Smoke," "Donegal Fairy Stories," "Ballads of a Country Boy," etc. Illustrated.

December 30: "From Babel to Esperanto—the Complication of Mother Tongues and the Simplicity of Esperanto." By Prof. A. Christen. Professor Christen is a leading authority on Esperanto. The growth of internationalism and the need of a world tongue lend interest to this topic. "Esperanto is spreading in almost every European nation, and is more easily learned and pronounced than any other foreign language. It is taught in all the higher military and naval schools of France, and at Lille has been taught in the public schools for the past three years."

January 6: "Arab Life in Tunisia." By Frank Edward Johnson. Mr. Johnson has probably seen more of the Barbary States than any other American. His lecture includes Tunis ("the White City"), the remains of Carthage and other buried Roman cities, Kairowan with its 85 mosques and 90 praying places, and descriptions of the Arabs in the oases and in the desert. Illustrated.

January 13: "The Methods, the Achievements and the Character of the Japanese." By Mr. George Kennan. Illustrated.

January 20: "Making Pictures. The Wonderful Development of the Art of Photography and its Value to Education and Commerce." By Hon. O. P. Austin, Chief of the United States Bureau of Statistics and Secretary of the National Geographic Society. Illustrated with motion pictures.

January 27: "The Panama Canal." By Col. George W. Goethals, Chief Engineer Panama Canal. Illustrated.

February 3: "Our Plant Immigrants." By Mr. David Fairchild, in charge of Agricultural Explorations of the Department of Agriculture. The hunt for valuable new plants and fruits takes the agricultural explorers to many unknown corners of the world, and is a fascinating story of achievement. Illustrated.

February 10: "The Balkan States." By Mr. E. M. Newman. With motion pictures.

February 17: "The Heart of Turkestan." By Mr. William E. Curtis. Illustrated.

February 24: "The Italy of To-day." By Maj. Gen. A. W. Greely, U. S. Army. General Greely has just returned to the United States after

spending a year in Italy, where he obtained much information as to the remarkable progress of modern Italy. Illustrated.

March 3: "The Birds of Mexico." By Mr. Frank M. Chapman, of the American Museum of Natural History. With motion pictures of roseate spoon-bills, man-'o-war birds and white ibises.

March 10: "From the Amazon to the Orinoco. The Five Guianas." By Mrs. Harriet Chalmers Adams. With motion pictures.

March 17: "Travels and Experiences in Mexico." By Mr. John Birkinbine, Ex-President of the American Institute of Mining Engineers. Illustrated.

March 24: "The Shrines of Greece; Olympia, Delphi, Eleusis, Athens, Mycenæ, Tiryns, Epidauros and the Island of Crete." By Miss Marion Cock. Illustrated.

March 31: "The Romance and Grandeur of Spain." By Dr. Charles Upson Clark, of Yale University. Illustrated.

April 7: It is hoped that former Vice-President Charles W. Fairbanks will be able to address the Society on this date on some subject connected with his recent journey around the world.

April 14: "The Fiords and Fisheries of Norway." By Dr. Hugh M. Smith, Deputy Commissioner of the Bureau of Fisheries. With motion pictures.

THE UNIVERSITY OF CHICAGO AND MR. ROCKEFELLER

At the convocation of the University of Chicago on December 20, the following letter from Mr. John D. Rockefeller to the president and trustees was read:

I have this day caused to be set aside for the University of Chicago, from the funds of the General Education Board, which are subject to my disposition, income-bearing securities of the present market value of approximately ten million dollars, the same to be delivered to the university in ten equal annual instalments beginning Jan. 1, 1911, each instalment to bear income to the university from the date of such delivery only. In a separate letter of even date my wishes regarding the investment and uses of the fund are more specifically expressed.

It is far better that the university be supported and enlarged by the gifts of many than by those of a single donor. This I have recognized from the beginning and, accordingly, have sought to assist you in enlisting the interest and securing the contributions of many others, at times by making my own gifts conditional on the gifts of others, and at times by aiding you by means of unconditional gifts to make the university as widely useful, worthy and attractive as possible. Most heartily do I recognize and rejoice in the generous response of the citizens of Chicago and the West.

Their contributions to the resources of the university have been, I believe, more than seven million dollars. It might, perhaps, be difficult to find a parallel to generosity so large and so widely distributed as this, exercised in behalf of an institution so recently founded. I desire to express my appreciation also of the extraordinary wisdom and fidelity which you as president and trustees have shown in conducting the affairs of the university.

In the multitude of students so quickly gathered, in the high character of the institution, in the variety and extent of original research, in the valuable contributions to human knowledge, in the uplifting influence of the university as a whole upon education throughout the West, my highest hopes have been far exceeded. It is these considerations, with others, that move me to sum up in a single and final gift, distributing its payment over a period of many years to come, such further contributions as I have purposed to make to the university.

The sum I now give is intended to make provision, with such gifts as may reasonably be expected from others, for such added buildings, equipment and endowment as the department thus far established will need. This gift completes the task which I have set before myself. The founding and support of new departments or the development of the varied and alluring field of applied science, including medicine, I leave to the wisdom of the trustees, as funds may be furnished for these purposes by other friends of the university.

In making an end of my gifts to the university, as I now do, and in withdrawing from the board of trustees, my personal representatives, whose resignations I enclose, I am acting on an early and permanent conviction that this great institution, being the property of the people, should be controlled, conducted and supported by the people in whose generous efforts for its upbuilding I have been permitted simply to cooperate; and I could wish to consecrate anew to the great cause of education, the funds which I have given, if that were possible; to present the institution a second time, in so far as I have aided in founding it, to the people of Chicago and the West; and to

express my hope that, under their management, and with their generous support, the university may be an increasing blessing to them, to their children and to future generations.

Very truly yours,
JOHN D. ROCKEFELLER

The trustees, in adopting a resolution expressing their grateful appreciation of Mr. Rockefeller's generosity, ordered spread upon the records a minute, a copy of which will be engraved and conveyed to Mr. Rockefeller by a special committee of the board. The minute reads in part:

The board of trustees of the University of Chicago accepts the gift made by Mr. Rockefeller and pledges itself to carry out in the spirit as well as in the letter, the conditions accompanying it. It is now twenty-one years since, in May, 1889, Mr. Rockefeller made his first gift to the University of Chicago. This final gift will make the total amount which the university will have received from its founder approximately thirty-five million dollars.

We know of no parallel in the history of educational benefactions to gifts so munificent bestowed upon a single institution of learning. But unique as they are in amount, they are still more remarkable for the spirit in which they have been bestowed. Mr. Rockefeller has never permitted the university to bear nis name, and consented to be called its founder only at the urgent request of the board of trustees. He has never suggested the appointment or removal of any professor. Whatever views may have been expressed by members of the faculty he has never indicated either assent or dissent. He has never interfered directly or indirectly with that freedom of opinion and expression which is the vital breath of a university, but has adhered without deviation to the principle that while it is important that university professors in their conclusions be correct, it is more important that in their teaching, they be free.

More significant still, this principle has been maintained even in his attitude toward the teaching of a subject so intimate as religion wherein the mind is keenly sensitive to differences of opinion. Although at times, doctrines have been voiced in the university which traverse those the founder is known to hold, he has never shown a desire to restrain that freedom which is quite as precious in theology as in other fields of thought. Such a relationship between a great benefactor and the institution which he has founded affords a motto for educational benefaction through all time to come.

SCIENTIFIC NOTES AND NEWS

IN this issue of SCIENCE is published the address of the retiring president of the American Association for the Advancement of Science. We hope to publish in succeeding issues the more important addresses and papers read at the meeting of the American Association and the national scientific societies together with reports of their proceedings.

THE Nobel prizes, amounting to about $40,000 each, were distributed by the King of Sweden on December 10 with the usual ceremonies. The prize-winners in science were present to receive their prizes and gave the statutory lectures. The recipients were, as already announced, Professors Van der Waals (physics), Wallach (chemistry) and Kossel (medicine).

CAMBRIDGE UNIVERSITY will confer the degree of doctor of science on Dr. George E. Hale, director of the Solar Observatory, on Mount Wilson.

THE bill to grant $250,000 for the construction of a monument to Commodore Perry at Put In Bay, O., and the holding of a centennial celebration in 1913 in commemoration of the battle of Lake Erie, has been favorably acted upon by the house committee on expositions.

THE French Society of Biology has awarded the Godard prize to Mlle. Anna Drzewina.

IT is announced from Cambridge that the special board for biology and geology has adjudged the Walsingham medal for 1910 to A. V. Hill, of Trinity College, for his essay entitled "The Heat Produced by Living Tissues, with Special Reference to Muscular Activity"; and a second Walsingham medal to J. C. F. Fryer, of Gonville and Caius College, for his essay entitled "The Structure and Formation of Aldabra and Neighboring Islands—with Notes on their Flora and Fauna."

DR. ALBERT ROSS HILL, president of the University of Missouri, delivered the address at the seventy-seventh convocation of the University of Chicago. His subject was

"Some Successes and Failures of the American College."

Lectures at the University of Wisconsin by Professor W. M. Davis, of Harvard University, will be given as follows: Two lectures on the Art of Geographical Description—Friday, January 20, "The Range of the Colorado Rockies"; Saturday, January 21, "A Study of the Italian Riviera." Two lectures on the Disciplinary Value of Geography—Monday, January 23, "The Nature of Proof"; Monday, January 23, "The Art of Presentation in Contrast with the Science of Investigation." Before the Science Club—Friday evening, January 20, "The Lessons of the Grand Canyon of the Colorado."

The Colleges of Engineering of the University of Illinois and Purdue University arrange each year a series of exchange lectures delivered by the members of the faculty of each institution. The first lecture delivered at Illinois this year was by Professor C. R. Moore, of Purdue, on "Power Manufacture and its Dangers."

Dr. J. A. L. Waddell, the bridge engineer of Kansas City, recently delivered two lectures before the faculty and students of the College of Engineering of the University of Illinois, one a technical talk on "Materials of Bridge Engineering and Foundations" and the other a general lecture on bridge construction.

The death is announced of Captain G. E. Shelley. After a short service in the Grenadier Guards, Captain Shelley retired from the army and devoted himself entirely to ornithology, especially to that of Africa.

The seventeenth annual meeting of the New York Zoological Society will be held in the Hotel Waldorf-Astoria, on Tuesday, January 10, at 8.30 o'clock P.M. Moving pictures showing the roping and capture of wild animals will be exhibited, and a series of colored slides showing whaling in Japanese seas will be presented by Mr. Roy C. Andrews.

In addition to the £2,500 voted to Captain Scott for his Antarctic expedition by the Australian commonwealth, a sum of equal amount has been contributed by a private donor in New Zealand, where Captain Scott has also met with liberal gifts in the form of stores.

A despatch from Paris tells of the burning of the branch of the Pasteur Institute at Garches, near Paris, on December 7. The branch was located in the Chateau Villeneuse l'Étang.

UNIVERSITY AND EDUCATIONAL NEWS

Public benefactions aggregating $370,000 are provided in the will of the late Mrs. William O. Moseley, of Newburyport, Mass. Two hundred thousand dollars are left to the Anna Jaques Hospital, of Newburyport, and $60,000 to Harvard University for the establishment of two fellowships to enable medical students of marked ability to pursue their medical studies abroad.

The next New Hampshire legislature will be asked to appropriate $163,000 for the State College, including $80,000 for a new engineering building and $40,000 for general expenses. The board of trustees are unanimously in favor of changing the name of the college from the "New Hampshire College of Agriculture and the Mechanic Arts" to the "University of New Hampshire."

On December 13, the board of trustees of the University of Illinois held their quarterly meeting at which the heads of the various university departments presented their requests for legislative appropriations for the biennium 1911–13. Large amounts were asked for buildings by the College of Agriculture, by the School of Education and College of Engineering, and for a school of Commerce.

A gift of $500,000 to Dartmouth College by Mr. Edward Tuck, has been announced. The donor states the object of his gift in the following words:

> I present these securities to the college to be added to the present Amos Tuck endowment fund. I desire the income from them to be applied as was the purpose of my original foundation of the fund of 1899, to the improvement of the existing

scale of salaries of the faculty of the college in all its departments as now constituted, and as increased later by the addition of the new professors and instructors including a librarian. I wish the trustees of the college to apportion the additional income received from the gift according to the relative importance and value, in their best judgment, of the services rendered in the different chairs, with due regard to length of service and to personal distinction.

A REUTER message from Kimberley states that the De Beers Company has made a donation of £25,000 towards the founding of a South African university.

FOR the purpose of furthering the educational relations between Germany and the United States, the announcement is made by Dr. Ernest Richard, of Columbia University, that a tour has been planned whereby American students can visit some of the leading German universities and come in personal contact with the German students and their ways of living. The tentative itinerary, in part, follows: Hamburg, Berlin, Leipzig, Goslar, Harz, Jena, Weimar, Dresden, Prague, Vienna, Nuremberg, Munich, Zurich, Strasburg, Heidelberg, Mainz, Wiesbaden, Frankfort, Halle, Marburg, Bonn, Cologne, Essen, Dinsburg, Dusseldorf, Bremen and London. The cost of the trip, which will last from sixty to sixty-three days, will be $600.

MR. HORACE G. PERRY, in 1909–10 assistant in botany at Harvard University, has been appointed professor of botany in Acadia College, N. S.

DISCUSSION AND CORRESPONDENCE

"GENOTYPE"

IN SCIENCE for October 28, 1910, p. 588, it is announced that the American Society of Naturalists will soon discuss "Genotypes or pure lines of Johannsen." It is not stated who is responsible for this use of the word "genotype" or whether it has ever been employed before in this sense. In any case it should be pointed out that the word "genotype," first proposed in your own pages by Dr. C. Schuchert[1] has since been used by systematic biologists in ever-increasing number to denote the type-species of a genus. The confusion of thought caused in the past by diverse uses of the word "type" in biology must not be perpetuated; hence I confidently appeal to those who want a single word for the "pure lines of Johannsen" to leave "genotype" alone with its usual significance, and indeed to avoid any word with the syllable "type" in its composition. It may save possibly trouble to point out that the concept of the "pure line" differs not only from that of the "genotype" as hitherto used, but also from that of the "genus-norm."[2]

F. A. BATHER

BRITISH MUSEUM (N. H.),
November 11, 1910

[1] April 23, 1897, p. 639.

[2] Bather, SCIENCE, May 28, 1897, p. 844.

QUOTATIONS

ACADEMIC AND INDUSTRIAL EFFICIENCY

OUR colleges and universities have been so long under fire, and in so many ways, that it is truly surprising that the fundamental trouble with them has remained so long unrevealed. But now that—thanks to the report made by a mechanical engineer to the Carnegie Foundation—the light of modern industrial methods has been thrown upon them, there will no longer be any excuse for their persistence in evil. It may take a little time, to be sure, to put the new standards and ideals into effective operation, but that is merely a detail. The new day has dawned, and the only question that remains is what institutions will be foremost in gaining the favor of far-sighted and broad-minded men of wealth by conforming their ways to the principles of industrial efficiency. Student-time-units per professor, number of pages of standardized lecture notes, coordination of janitor-work with teaching-time, and a score of other measurements of efficiency which will occur to every competent college president, will take the place of those vague and intangible ways of estimating the merits of our institutions of learning that have hitherto prevailed. To argue the merits of the change would be a waste of words. In this age of industrial and commercial advance,

a reform which means progress toward mechanical standardization of methods and values is sure to receive so universal a welcome that its success is assured from the start.

While, therefore, the merits of a proposal to standardize our universities, abolish life tenure of professorships, and regulate research, speak for themselves, it is somewhat interesting, perhaps, to speculate on the probable origin of the idea. And here we venture a conjecture which we think must commend itself to the judicious. It is not so much to the defects of our own universities, we imagine, that the scheme owes its inception, but rather to the notorious failure of the universities of Germany, in which these defects have been far more pronounced. There they have never even had such a thing as a college president; and the professors have not only had an absolute life tenure, but have been allowed a degree of liberty in teaching that is simply scandalous. This has been going on for generation after generation, and everybody knows the result. German students have been slipshod and inaccurate, and no foreigner has gone to a German book for enlightenment or to a German university for training. As for research, these Germans have simply run riot; a German professor will spend years of his own time and that of his students in some obscure research, without asking anybody's advice or consent. And the consequence has been not only that deplorable intellectual sterility to which we have already referred, but a backwardness in the arts and industries depending on the applications of science—the chemical industries, for example—which has made modern Germany a laughing stock to her European neighbors. If we wish to avoid a like fate, we must hasten to standardize our universities, set time-clocks on the professors, and guard with scrupulous care against the spending of either time or money on any research that has not secured the formal approval of the president of the university, the board of trustees, and the Consolidated Audit Company.—*New York Evening Post.*

THERE is no question of the amount of time wasted by professors, lecturers and instructors who speak slowly. A table prepared from my own notes gives the average word production of six "eminent" men in the lecture hall:

Professor	Subjects	Words a Minute
Binks	Mathematics	93[1]
Jones	English	142
Smith	Physics	236[2]
Brown	History	191
Black	Chemistry	201
Squib	Greek	84

It is evident that the amount of work done by Smith is much in excess of that done by any of the others whose word production is set forth here. The distressing showing made by Binks and Squib needs no comment. It is plain that they are not giving full value for their money, as is Smith. It is true that Binks is an old man and has achieved something of a reputation among astronomers and that his lectures are largely attended, and that Squib has written several books which I have not had time to read, but these are matters of minor importance. The case of Brown is of peculiar interest, because I have been informed that his usual word-production does not exceed 120 + a minute. I caught him as he was addressing his class on the subject of the abstraction of his spectacles from their accustomed place. In his excitement his word production increased, and thus his capacity for more rapid speech was proved beyond question. I recommend that a satisfactory standard of word production be adopted, and that all professors, lecturers and instructors attain this average or suffer appropriate reduction in their pay.

This brings us naturally to the consideration of the time card in relation to education. It is already in use as affecting the students, but their instructors do not submit themselves to it. They should be obliged to do so. A system of time checks and cards would bring these men to their senses and teach them to be punctual.

Finally, I desire to direct attention to the fact that not one of my suggestions for the improvement of the administration of insti-

[1] Cleared throat four times.

[2] Did not clear throat once.

tutions of learning is merely theoretical or even experimental. All have been tried out in practise with excellent results. I can go to any one of hundreds of retail clothing shops, steel foundries, fish markets, woollen mills, great excavation firms, and the like, and get at a moment's notice scores of alert, capable men, properly trained and disciplined, who would be willing to undertake, for suitable compensation, the entire rearrangement and standardization of any college or university, and would guarantee to bring about results that would amaze any professor of Greek or Sanskrit that ever lived.—*Extracts from a report by N. J. Snook, M.R., to the trustees of the Buncombe Fund as presented in the New York Sun.*

SCIENTIFIC BOOKS

Physical and Commercial Geography: A Study of Certain Controlling Conditions of Commerce. By H. E. GREGORY, A. G. KELLER and A. L. BISHOP, Professors in Yale University. 8vo. Pp. viii + 469; figs. 26, pls. 3. Boston, Ginn & Co. 1910. $3.00.

When twenty years ago Mr. Geo. G. Chisholm published his most excellent "Manual of Commercial Geography," he virtually created a new subject of study in English-speaking schools and colleges. America was ready for such a line of study, and the demand for a text has called into existence a goodly number of books, but a reviewer scanning them one after another discovers in all of them a more or less slightly disguised Chisholm, in a condensed form. The attempt to present the principles of commerce, the commodities of commerce, and the commercial countries all in one small volume, has resulted in the assembling of endless statistics, often with little juice, and less geography.

This, the latest American contribution to the subject, is an earnest attempt to go to the roots of things, and to plant the commercial activity of the world upon a philosophical basis, recognizing all the factors at work, but giving special attention to the geographic influences, and especially to the human element involved.

The book is divided into three parts, spaced about equally: I., The Natural Environment; II., Relation of Man to Natural Conditions; III., The Geography of Trade. The spirit of treatment is commendable. The authors realize that "it is interpretation rather than arbitrary memorizing which is of educational importance."

In Part I. commerce and the human point of view have been kept well in the foreground, though the choice of material is not always defensible. For if the student comes to this work with no preparation in physiography, this presentation will not give him the grounding he should have. And if the student brings to it the training in physiography of a good high school, much of the material here is superfluous.

The following suggestions are offered on Part I.: For the space allowed in illustrating harbors any one outside of Connecticut might complain of the prominence given to the insignificant harbors of that state (pp. 32–3). On page 93 we learn that "For some reason, animals have learned to use diluted oxygen rather than the more abundant nitrogen. . . ." One might infer that it was a matter of poor taste or bad judgment on the part of the animals! By implication the great capacity of water for heat is due to transparency and evaporation (p. 102). The principle of specific heat, in this case so important, can not be read in or between these lines. On page 106 we read "The temperature of space outside the atmosphere is probably the 'absolute zero'"—Langley's researches give us an estimate of about 5° C. above absolute zero. On page 121 ff. the form "survival of the fitter" occurs, as a suggested improvement over the classic form "fittest." This suggestion is evidently based upon the misapprehension that only two stages, the positive and comparative, are involved. As a matter of fact in any case where the original and proper term "fittest" is used, there are innumerable individuals involved, and it may be also innumerable stages or phases of adaptation, and the final term only is described. Nor has any one who ever used the term "fittest" in this sense thought for

a moment that it was the ultimate possible term in the series. The use of "fitter" is pedantic, and it is a pity to put it into a text-book.

Part II., The Relation of Man and Natural Conditions, is in its point of view and horizon, a distinct contribution. It is by all means the best part of the book. Here the human element, with a decidedly biological perspective, is made the theme, with very suggestive treatment. Yet a number of criticisms are invited: To notice only a few of them: On p. 126 it is said "Every alteration of any importance in their environment sets before the animal or plant, as has just been seen, a series of alternatives: death, degeneration, flight, or adaptation." There should be but three alternatives. By any analysis, degeneration must be considered one phase of adaptation. Further down this page a misapprehension is certainly provided when it is stated that no change in the human physique is of record. The Neanderthal and Spy and other early men most certainly could not "well be duplicated among men of to-day." On p. 130 there is a very patent shrinking from being identified with "determinism," which is almost humorous. The whole point of such a book as this lies in the constant, specific evidence it brings of "determinism." Why shrink? On p. 144 we find: "Life in deep forests is passed in a sort of gloom;—*the impenetrable 'scrub' of Australia* occupies the surface of the earth to man's almost total exclusion!" Shades of Schimper and Schomburgk! On the next page the statement "the microscopic fauna, the living germs of disease," puts plague, leprosy and tuberculosis among diseases due to *animal* parasites, while every one should know that these diseases are due to bacteria. On p. 146 our freedom from small-pox, and our lack of fear of it is made due to an immunity we have acquired by long association with it! (not to vaccination). On p. 149 cocaine is made the essential principle of the "cocanut." As a matter of fact *Erythroxylon coca* has no "nut," only a seed in a capsule, which is not used as a source of cocaine. It really sounds as if the author's cocaine comes from a coconut. On p. 157 we read "Practically all the grains but maize, all the fruits, all the spices and condiments, all the textile products, vegetal and animal, and practically all the domesticated animals come from this region (Eurasia)." This is too inclusive. The pineapple and a number of other tropical fruits are natives of America; so is allspice; so are vanilla and cocoa; cotton was native here as well as in Asia; the alpaca and vicugna wool was extensively used in prehistoric Peru; and the dog and llama were the servants of the native Americans before 1492. The word "controlling" (p. 179) is much too strong. Most of the geographic influences referred to are merely modifying.

The authors have trouble with the race question and with the tropics. One might infer (p. 188) that there is such a thing known as a "pure" race. What is there more "mongrel," to use the offensive term, than the English or Spanish or Italian or Japanese stock? It is quite unfair to charge the whole record of the Spanish-American republics to race mixture. It is worthy of note that one of these governments with the proudest of records, Chile, has about the most complete blend of Spanish and Indian. The authors have no right to speak for America when they say "we do not reckon the mulattoes of this country as an important element of our national strength." It is safe to say that they are quite as important as an equal number of "poor whites" or of several other elements of the middle and lower classes. As to the tropics, on one page we find "The yellow race seems to have little difficulty in acclimatization in any region"; and again, "The Chinese have made effective coolies and are now the best free-labor force applicable to the development of the hot regions"—and yet the paragraph is ended with the obsolescent suspicion that the tropics can never be fully utilized, because the western nations can not thrive in the tropics with their mid-latitude habits and ways of life. The Chinese will teach us a lesson in the development of the tropics one of these days, in spite of our "strong prejudice, partially justifiable and mainly not."

Part III. is devoted to the Geography of Trade. To treat "each important product in detail under the particular country which leads in its production or in some cases in its elaboration," has always been questionable as a method, and the authors have not succeeded in overcoming its drawbacks. While only the United States, the British Empire and Germany are treated, there is need of constant repetition in the discussion of given products, and still an added chapter is required for articles not treated under countries. Then, too, the space allowed is too small, and the treatment of countries becomes as usual so much abbreviated, as to fall into the old form of mere statistics. With discussion so condensed it is not always possible to distribute emphasis fairly. Thus we find that Germany gets no more space than Australasia, and though South Africa is given six pages there is no room for France.

We all realize that coal and iron are the bases of modern commerce, yet the iron industry gets no more space than cocoa and platinum, two items of insignificant value; and coal claims no more room than hemp, buckwheat and barley. The very great significance in industry and commerce of copper, clay, cement and the phosphates is quite overlooked, for buckwheat looms larger than copper; the clay industries get only two and one half inches; and cement and the phosphates occupy only as much space as the two words require, and that in eight-point type.

It is the firm conviction of the reviewer that the plan is illogical of attempting to mix the commodity and the country in a general text-book. To attempt it is to make both the commodity and the country suffer, as this book demonstrates anew. The field is amply large, and the geographic and teaching values are adequate, to make the commodity point of view sufficient for a general survey. If it is desired to take the country point of view it should be done as a course apart and in addition, and with space enough so that some geographic interpretation can be attempted. Certainly no adequate geographic study can be given of a country like Germany, in eleven pages as here. The trouble is we are attempting far too much in one course, or in a brief survey. The authors might give a much better account of themselves were they to devote Part III. either to commerce and its commodities alone, or to America alone.

In spite of the many errors in detail, only a few of which are here noticed, and which would largely be eliminated by better team work on the part of the authors, and by more careful editorial supervision, the text stands as a distinct advance over its American predecessors.

J. PAUL GOODE

THE UNIVERSITY OF CHICAGO,
November 28, 1910

CHEMICAL TEXT-BOOKS

A Text-book of Organic Chemistry. By A. F. HOLLEMAN, Ph.D., F.R.A. Amst., Professor Ordinarius in the University of Amsterdam. Edited by A. JAMIESON WALKER, Ph.D., B.A., Head of the Department of Chemistry, Technical College, Derby, England; assisted by OWEN E. MOTT, Ph.D., with the cooperation of the author. Third English edition, partly rewritten. First thousand. New York, John Wiley and Sons. 1910. Pp. 599, 80 figures. $2.50.

A long review of the second edition of this book appeared in this JOURNAL.[1] That a new edition is required in less than three years indicates the deserved reputation of Professor Holleman's book.

In the present edition the author has rewritten the chapter on proteins, which with that on amino-acids now follows the chapter on sugars. Dr. Walker has introduced the protein classification adopted by the Chemical Society of London jointly with the English and American Physiological Societies, and the American Society of Physiological Chemists.

A repetition of the detailed review referred to is not necessary. It is enough to quote from the author's preface: "This book is essentially a text-book and makes no claim to be a 'Beilstein' in a very compressed form," and

[1] Vol. XXVI., 1907, p. 791.

to say that while it is scarce a text-book for beginners, it is probably our best *text-book* of organic chemistry for advanced students.

E. Renouf

Essentials of Chemistry, experimental, descriptive, theoretical. By Rufus Phillips Williams, Teacher of Chemistry in the English High School, Boston. Boston, Ginn and Co. 1910.

This is an excellent manual for schools, very fully illustrated with portraits and with pictures of apparatus. It contains many instructive, qualitative and quantitative experiments, and technical methods are fully explained.

Outlines of Organic Chemistry. A book designed especially for the general student. By F. J. Moore, Ph.D., Associate Professor of Organic Chemistry in the Massachusetts Institute of Technology. New York, John Wiley and Sons. Pp. 315.

This book is of the same size and general contents as most college text-books of organic chemistry, but especial attention is paid to those substances which are of importance in daily life, in vital processes, or are of especial commercial value, such as oils, sugars, cellulose-derivatives, urea, amino-acids, proteins. The size of the book restricts the number of compounds presented, but the presentation of those chosen is scientific and complete. The treatment of the sugars is excellent, in its clear showing of the essential part of Fischer's work. It is an exceptionally good book for study.

Analytical Chemistry. By F. P. Treadwell, Ph.D., Professor of Analytical Chemistry in the Polytechnic Institute of Zurich. Authorized translation from the German by William T. Hall, S.B., Instructor in Chemistry, Massachusetts Institute of Technology. Volume II., Quantitative Analysis. Second edition, thoroughly revised and enlarged. Total issue, six thousand. New York, John Wiley and Sons. 1910. Pp. 787, 110 figures. $4.00.

Professor Treadwell's books on "Analysis" were first published in German in 1899 and have a large circulation abroad. In 1903 Mr. Hall published his translation of the volume on qualitative analysis; this was followed in 1904 by the volume on quantitative, of which the present volume is the second edition. Six thousand copies printed indicate the favorable reception of the book in this country and in England.

Mr. Hall has compared the text with the fourth German edition and has made additions, rendering the book more helpful to American chemists.

On comparing Treadwell's books with the older manuals one is impressed by the simplicity of arrangement and by the wise and careful choice of methods. Instead of presenting a host of alternate methods to the student who is incompetent to estimate their relative value, he gives a full description, often illustrated, of those most approved.

The additions made by the translator comprise well-tried American methods, most of them technical. Among them are A. A. Blair's methods for determining vanadium, molybdenum, chromium, nickel and phosphorus in steel; the dry combustion method for carbon, the Drown method for determining silicon, both in use at the Bureau of Standards, and the improvements of Hillebrand in mineral analysis.

E. Renouf

The Johns Hopkins University

SPECIAL ARTICLES

NOTES ON THE PASSENGER PIGEON

A well-written special from New York to the Chicago *Evening Post* (printed December 2, 1910) stating that "A solitary passenger pigeon, ending its life at the Zoological Garden at Cincinnati, is to-day all that remains of the species that early in the last century swarmed over the continent in flocks numbering billions," suggests the desirability of adding to the occasional notes on this native bird a record of personal observations.

I

During early life in eastern Iowa it was my fortune to see much of the passenger pigeon.

The family home in western-central Dubuque County stood just west of the woodland belt extending to the Mississippi, and some four miles east of the woodland belt skirting the Maquoqueta; the two wooded areas converging somewhat northward, so that the vernal flights may have been somewhat concentrated. The pigeons appeared regularly every spring (in the sixties and early seventies) about the time of wheat sowing; most farmers aiming to postpone the sowing until after the pigeon migration. Ordinarily the flights extended over two or three days or even more, though the chief movement usually occurred during a single day. The flocks commonly appeared over the southern horizon as dark, moving bands, one after another at intervals of a few minutes, quickly resolving themselves into myriads of birds flying northward at a height of a hundred or a hundred and fifty feet, at the rate of, say, sixty miles an hour; an average flock was, say, a hundred yards in width from front to rear and half that height, frequently extending eastward over the woodlands and westward far as the eye could reach, nearly or quite to the Maquoqueta groves four miles away; the closeness of the flight being such that a flock obscured or even concealed the sun during its passage and cast a definite shadow which might be seen to move over the ground like that of a cloud—such that the random discharge of a shotgun or even a rifle upward usually brought down a number of birds. When fired into the sound of the myriad wings changed from a sort of shrill roar into thunderous tumult, both sounds being distinctive and easily remembered. The flocks were always irregular in width and height, occasionally thinning out or even separating into a phalanx of fairly distinct flocks maintaining about the same height and rate of movement in the same latitudinal line; but the large flocks were always the more extended at right angles to the line of flight, though those of only a few thousand birds preceding or following the main flights were longer front to rear, sometimes tailing out in irregular lines of stragglers evidently unable to keep up with those of greater strength. The large flocks seldom alighted; and though the main flights commonly occurred between midforenoon and midafternoon, they sometimes continued into the night, when the passage was marked by the rustling, whistling roar of wings audible for some minutes before and after the actual passage of each flock. The smaller flocks frequently settled either to rest for a time or to feed in the woodlands; they first alighted on trees, often in such numbers that the branches were bent and frequently broken by their weight, and generally after resting a fraction of a minute flew down individually to the ground in search of acorns and other mast. When startled, they arose from trees and ground with a roar of wings audible for miles, while if not frightened by hunters or otherwise they arose more gradually and in the course of a quarter or half an hour were gone. Over the prairie between the woodlands the flocks were never seen to alight save now and then on a wheat field; even here all were never on the ground at once, but the flight, as it were, rolled over the field, the birds in the lead alighting to scratch out and pick up the newly-sown wheat, and then arise as the body of the flock passed over them to again fly to the front and repeat the process, so that each was a part of the time in the air and a part on the ground—and the entire field was robbed of its seed within a few minutes. Chiefly because of their avidity for wheat, partly because of their injury to trees by breaking branches, the pigeons were deemed a pest; yet no local defense was employed save that of energetic shooting into the flocks, killing a few hundreds annually which were used for food, and frightening the rest. There were no pigeon roosts or rookeries anywhere in the countryside, though on two or three occasions the early flights encountered storms and harbored for a few days at a time in the woodlands, where in at least one case many died. Such are merely the commonplace facts of the vernal migrations of the passenger pigeon in a representative locality—facts such as those observed

and sometimes recorded elsewhere, especially further eastward through Illinois, Indiana, Ohio and Michigan.

A rough estimate of the number of birds passing a given point in a spring may be useful. The cross-section of an average flock was, say, a hundred yards from front to rear, and fifty yards in height, and when the birds were so close as to cast a continuous shadow there must have been fully one pigeon per cubic yard of space, or 5,000 to each linear yard of east-west extension—*i. e.*, 8,800,000 to the mile, or (with reasonable allowance for the occasional thinning of the flock) say 30,000,000 for a flock extending from one woodland to the other. Since such flocks passed repeatedly during the greater part of the day of chief flight at intervals of a few minutes, the aggregate number of birds must have approached 120,000,000 an hour for, say, five hours, or six hundred million pigeons virtually visible from a single point in the culminating part of a single typical migration.

While the passenger pigeon migrated annually and in vast numbers over eastern Iowa, far exceeding the aggregate of all other migratory birds and water fowl combined, there was an irregularity of movement suggesting absence of a definite and long-established migratory habit such as that, *e. g.*, of the water fowl passing the same point. In the first place the migration was not well adjusted to the season: Frequently the pigeon was the first migrant to appear, arriving sometimes after one or two warm days of southerly wind while yet the snow remained, so that they were liable to be caught by cold and storms; while geese, cranes and various ducks came generally later (though sometimes earlier) when the season was so settled that they rarely, if ever, suffered from cold, old snow and ice, or belated storms. In the second place the pigeon flocks seemed wholly unorganized. Unlike the geese and cranes and most of the ducks, which flew in oblique lines or V's following a leader and on alighting kept sentinels on guard, the pigeon flocks were without visible leadership, the multitude merely hurrying forward with the stronger flyers toward the front, but constantly interchanging position, and when they alighted on trees and then flew down to forage on the ground each bird apparently moved according to its individual caprice, and no sentinels were left save by chance; the entire flight of the day, if not of the season, seemed to be that of a promiscuous horde of individuals, fortuitously broken up, as it were, into a series of successive waves in which each bird sought merely to remain near the others, veering to the right or left rather than forging to the front if of superior strength, in such manner as to extend the flock laterally rather than in the line of flight—apparently the smaller flocks appearing toward the end of migration were of birds left behind either by belated start or because of inferior strength, and being unequal in freshness or power of flight they strung out longitudinally rather than spreading laterally like the more numerous and more vigorous flyers. Again, unlike the water fowl which returned southward in the autumn in larger numbers than in the spring flight, the pigeons had no autumnal migration; about September and October they were a little more numerous than during the summer, and might occasionally be seen in twos, threes, fours or rarely in larger groups flying southward rather irregularly; but there was no general return of the vast hordes moving northward in the spring—it was as if the excess of birds annually went out to their destruction as the Norwegian lemming are said occasionally to rush to their death in the sea. Like the water fowl, the pigeons undoubtedly nested and bred in the north, though their chief breeding grounds must have been in the south, whence the vast flocks moved northward with the advent of spring, apparently in a desperate food-quest which might or might not be successful.

Most records of the passenger pigeon note the flight of the flocks and perhaps the collective nesting, but not the scattered breeding within the zone covered by the migration. In eastern Iowa individual pigeons left the vernal flocks in considerable numbers and remained to pair, nest and produce young—the number

so remaining being such that, excepting possibly the gray squirrel, they were the most abundant small game of the woodlands during the season from April to October. In nesting there was no collective habit among the birds; each pair seemed entirely independent of others, and the nests were irregularly distributed throughout the woodlands, no two very close together nor much alike in position. Perhaps the favorite sites were among the thick and thorny branches of haw trees, growing about the woodland margins and within ravines too wet for ordinary forest growth; sometimes they were within the forest at the base of one or two large branches projecting from a tree-trunk; again they were on broken stubs some yards high; sometimes they were in crannies or even on the surface of projecting rocks; and rarely they were on the ground in hilly places of low shrubbery. They were never noted more than fifteen or twenty feet above the ground. Wherever located, the nests were much alike, being rudely built platforms of large twigs usually six or eight inches long, so arranged as to form a slight concavity within which two white eggs (rarely one) were laid; the platform was eight or ten inches across, and the tail of the sitting bird projected beyond it on the better protected side. In the course of the incubation stray feathers and excrement partly covered the twigs, so that by the time the young were hatched the nest was moderately smooth and symmetrical within, though always rudely irregular and apparently on the verge of wreckage without. At first clumsy and helpless and nearly featherless, the young, fed by both parents, grew rapidly and their crops distended until about as large as the rest of the nestlings; and they were able to fly perhaps within three weeks after hatching, when for a few days longer they remained inordinately fat and awkward and were fed by the old birds as they perched on branches; this occurring about June, when the woods were in their quietest and most umbrageous condition. Thereafter for some two months the old birds and the young formed a family group, feeding and roosting near together, and seldom far apart, but not associating with other families; and it was apparently these groups or their survivors that winged their way southward as families and never as flocks with the approach of autumn. Between the arrival in late March or April and the departure in early October, the pigeons were easy quarry for small-game hunters and also for birds and animals of prey, so that the family groups flying southward averaged less than three; and probably from this neighborhood fewer pigeons flew southward in autumn than remained from the spring migration. Rarely a group of five or even six appeared, and there were few solitary flights, so it seems probable that depleted family groups sometimes united.

The food of the pigeons nesting in Iowa as shown by the contents of their crops was largely acorns and miscellaneous mast; and when the vernal flights rested their food was similar, except where they despoiled wheat fields of the seed grain. The crops of the birds shot in the early flights contained seeds and buds popularly reputed to be from Louisiana, but not systematically identified; though generally the crops were nearly empty. My first game was a pigeon, shot about 1862; thereafter for a dozen years I shot, say, a score annually, about equally divided between spring migrants and local birds taken in late summer and autumn.

From the early sixties the pigeon migrations declined. In the early seventies occasional flocks of diminishing numbers continued to fly in spring, a considerable part of them remaining to breed; then about 1876 these ceased, and the passenger pigeon became extinct in eastern Iowa.

II

In 1894 and 1895 and again in 1900 I conducted expeditions through southern Arizona and western Sonora, and saw something of what the camp men called "Sonora pigeons." The birds were seen singly and by twos and threes, either distant or in flight which was noted as resembling that of the passenger pigeon. In 1905 I spent some four months at the desert water of Tinajas Altas in the flanks

of Sierra Gila, seventy-five miles southeast of Yuma and near the Mexican boundary, and there had opportunities for observing what appeared to be the same bird—which was soon identified with the passenger pigeon as known in Iowa a quarter-century before. It was similar in size, the males 16 or 17 inches in length from beak to tail-tip and 24 or 25 inches in wing spread, the females somewhat smaller; it was essentially similar in color and appearance of plumage (possibly a shade more pallid), slaty bluish gray with rufous breast and a sort of iridescent sheen on the sides of the neck, with soft and down-like white feathering about the ventral region and thighs, and white showing in the tail feathers as the bird started up or alighted, the females less rufous and sheeny than the males. The size, form and color of the beak were similar, the upper mandible projecting slightly at tip and sides, with small rugosities about the nostrils, and a narrow, reddish, fleshy line marking off the base of the upper mandible from the fine and smooth feathering of the head, while the head was similar in form and size and in the peculiar backward, courtesy-like movement apparently attending a change in focus in the bird's vision. The legs and feet were the same in size, form and reddish color, the small and rather brilliant carmine scales separated by narrow whitish lines, the lower surfaces purplish and the claws nearly black. The tail—perhaps the most striking feature—was similar, its length half that of the entire bird, with two large black feathers much longer than the rest forming the center, and the lateral feathers shortening rapidly so that when spread in flight its outline was that of a diamond or rhomb with one of the acuter angles merging into the body of the bird; alight but alert, the tail pressed upward against the projecting wing tips so that the three united in a slender tapering point, though at complete rest and in balancing on a perch the tail dropped downward, separating from the wing tips. The form and general appearance were the same, the neck long, sinuous and extensible, the body elongated and slender, giving the appearance of smooth stream-lines as of a swift water craft, the exposed surface of the larger feathers smooth and glossy. The plucked skin was similar, dark purplish, especially over the breast, and grading through pink to nearly white over the back; and the flesh was similarly dark, and of the same flavor when cooked. The movement in flight was similar, the birds starting up with sharp clapping of the wing tips as they met below the body, commonly flying in easy swiftness with nearly continuous wing beating accompanied by endless tail movements, including contraction and expansion of the feathers from a narrow line to a width of fully six inches; and on approaching a perch the wing tips again clapping, though more softly than on arising. An unusual form or trick of flight noted in Iowa was that in which the bird descended from a lofty perch as on a high tree-top by a sort of dive without much wing movement; launching itself obliquely downward, with tail half spread and wings opened but strongly flexed, so that its outline was that of a trident moving stem forward, it vol-planed through the air so swiftly as to produce a low, rushing or whistling sound, veering laterally by tilting the body sidewise, in an up-curving trajectory carrying its movement above the horizontal with diminishing velocity as it approached low perch or ground, on which it came to rest after gentle flapping. At Tinajas Altas in May the pigeons (then nesting) commonly watered at one of the lower water pockets a hundred yards west of and a hundred feet higher than the camp, returning thence to the clump of trees containing the nests at the mouth of the canyon two hundred yards eastward and seventy-five feet lower; they generally arose from the water pocket so as to pass high above the camp, and then set themselves to a vol-plane flight back to the nest-trees, holding the flexed wings firmly fixed and guiding the course with bendings of tail and head and lateral rocking motions of body and wings—the fashion of flight being precisely that noted among the passenger pigeons of Iowa and never seen in any other bird. There was also a high water pocket 400 yards west of camp and 400 feet

higher, at which hawks and mountain sheep habitually watered. From time to time during May attention was caught by a rushing sound in the air above camp, for which no cause was for some time visible; it came unexpectedly, and by the time the eyes were turned in its direction nothing was to be seen. Finally my temporary companion, José—a Papago Indian trailer of notably acute vision—set himself facing down the canyon and watching the space above and before him; after some hours of patient waiting the sound recurred, and he was rewarded by sight of a pigeon coming into view in the line of his vision and vol-planing down to the nest-trees; and thereafter glimpses of passing shadows in the air were twice or thrice caught an instant before the rushing sound was heard—for sometimes the birds went up to the high tanque for water and vol-planed back with such incredible swiftness as to be nearly indistinguishable by the eye except when they chanced to cross the line of vision already directed and focused about their distance.

At Tinajas Altas some fifteen or twenty pairs of the pigeons were nesting in May. The nests, chiefly in the thick branches of an ironwood tree with three or four in neighboring mesquites in a little tree clump at the mouth of the canyon, like those in the haw trees of Iowa, were rude platforms of twigs partly covered with loose feathers and excrement, though apparently old and repaired for the season. The old birds were seen feeding on buds and seeds, including the fleshy blossoms of the *Dasylyrion* (none were taken at this time). Toward the end of May the young appeared in the trees about the nests, black, ill-fledged, fat and clumsy, and were apparently still fed and watered by the parents for a day or two; then the whole colony, young and old, unexpectedly disappeared about the first of June. Thenceforward until late July, midsummer heat held Tinajas Altas hard, and vitality waned save in the growth of the *Dasylyrion* on the rocks and the cacti on the plains; the chuckawalla went into estivation in deep crevices in the granite, and most of the other lizards disappeared, some of them to come out of their holes occasionally during the early morning; the active little striped squirrel no longer ran over the heated rocks; the buzzing insects and humming-birds of May were gone, and the silence of the sun-scorching day was seldom broken save by the occasional shrieks of hawks far up in the air or by the rustle of the wings of vultures or the leap or bleat of mountain sheep seeking water. Toward the end of July the cactus fruits—chiefly of saguaro and pitahaya—began to ripen, and the seeds of the scanty grasses and other inconspicuous plants approached maturity; then California quail appeared in pairs of adults, each with an extensive brood of young apparently at first unable to fly (whence they came was a puzzle, since only a single quail—a solitary male—was seen or heard during May, and there was no other water within a score of miles). Next came doves; and by the first of August the pigeons returned, apparently in somewhat larger numbers than the parents and young of May combined—there were probably between a hundred and a hundred and fifty in all. Although all watered about the same time morning and afternoon, they gathered about the water, rested, and flew over the plain in search of food, in family groups of three or four, in which the young, although fully grown, were still distinguishable chiefly by pallid or mottled breasts.

The camp larder being about exhausted, some thirty of the pigeons with an equal number of quail and three or four doves were shot during August (two mountain sheep were also shot and eaten during the season). The crops of pigeon, dove and quail were filled chiefly with cactus fruits, with a few miscellaneous seeds. The weight of body and the food value of the pigeon were somewhat greater than that of the quail, two or three times that of the dove; and in a fricassee with rice and shredded bacon the birds were no less delectable than the memorable pigeon pie of Iowa during the sixties. Toward the end of August, rains occurred in the Cabeza de Prieta range, a dozen miles eastward, and the pigeon and quail (made timid by the shoot-

ing) suddenly disappeared, apparently crossing the valley to that range. Lack of facilities and unexpectedly hasty abandonment of the camp unfortunately prevented preservation of skins of the birds.

The Sonora pigeon (at least the bird observed at Tinajas Altas) differs so widely as to be readily distinguishable from the mourning dove in size, in form and relative length of tail, in mode of flight, in greater glossiness of plumage, in the rufous breast and sheeny neck and the absence of the dark spot on the side of the neck, in color of legs and feet and in color of skin and flesh; and it differs from the band-tail pigeon (well-known, *e. g.*, in Kern River Valley, California, where it was seen ingeniously snared by Indians) in more graceful slenderness of body, in mode of flight, in color, in trim and compact feet, red instead of yellowish, and especially in the elongated and mobile tail; and there seem to be no other southwestern forms with which it could be confounded.

W J McGee

Washington, D. C.,
December 13, 1910

SCIENTIFIC JOURNALS AND ARTICLES

Owing to the recent death of Dr. Christian A. Herter, editor in chief, inquiries have been made regarding the future of the *Journal of Biological Chemistry*. It is therefore proper that those who have been interested in the journal should be assured of its continuance in its present form. A statement of certain circumstances connected with the foundation of the journal will give this assurance. In order that it should not become wholly dependent upon one individual, Dr. Christian A. Herter, one of its founders, invited four others to join with him in the formation of a corporation, which should have as its sole purpose the creation, conduct and continuation of the journal. The corporation will now assume full charge of the journal and continue the publication without interruption. It is the purpose of the remaining members of the corporation to adhere to the traditions established by Dr. Herter. The loss of Dr. Herter from the management of the journal necessitates some reorganization of the editorial staff. This will be undertaken in the immediate future by the corporation. The office of the journal will continue to be at 819 Madison Avenue, New York, N. Y. Manuscripts may be sent to this address, or to Prof. A. N. Richards, University of Pennsylvania, Medical Department, Philadelphia, Pa.

The contents of *Terrestrial Magnetism and Atmospheric Electricity* for December, 1910, are as follows: Portrait of Robert Were Fox; "Proceedings of the Berlin Meeting of the Commission on the Magnetic Survey of a Parallel of the International Association of Academies," by Adolf Schmidt; "Proceedings of the Berlin Meeting of the Commission on Terrestrial Magnetism and Atmospheric Electricity of the International Meteorological Committee," by Adolf Schmidt; "The Work of the Magnetic Commission of the International Meteorological Committee, 1896–1910," Editorial Review; "Life and Work of Robert Were Fox, 1789–1877," by L. A. Bauer; "On Precursors of Magnetic Storms," by R. L. Faris; "Record of Lightning Stroke at Cheltenham Magnetic Observatory," by R. L. Faris; "The Physical Theory of the Earth's Magnetic and Electric Phenomena, No. II.," by L. A. Bauer; Letters to Editor and Reviews.

BOTANICAL NOTES

A MUCH NEEDED BOOK

Every botanist who has had to help students who wish to know something as to the names and classification of the commonly grown shrubs in private and public grounds has felt the need of a book of moderate size and cost which deals with these plants. Even Dr. Gray felt this need, and more than forty-seven years ago he brought together a "Garden Botany" supplement to the fourth edition of his "Manual." A little later he compiled the "Field, Forest and Garden Botany," which in spite of its imperfections was very useful to the young botanists of that period, as is the now out-of-date second edition of the same book. When Professor Bailey

brought out the "Cyclopedia of American Horticulture" he covered the whole field here referred to most completely, but the four- to six-volume size of the work, together with its very considerable cost, practically prohibits its ownership by the individual student.

So it is with most hearty approval that the writer opens the little book entitled "Ornamental Shrubs of the United States," by the late Professor Austin C. Apgar (American Book Company). In 352 small octavo pages the author has packed away a great deal of information as to the shrubs one is likely to meet in the eastern part of the country, and his brief descriptions are helped out by 621 wood-cuts which accompany the text. Those who are familiar with Apgar's "Trees of the Northern United States" will find in this book a counterpart to that very useful book of fifteen to twenty years ago, before the appearance of Britton and Brown's "Illustrated Flora," or Sargent's "Trees of North America." Apgar's "Trees" was the forerunner of our illustrated manuals, and it taught us the value of properly selected drawings as aids to the more formal descriptions, a lesson which has not been lost upon later authors.

The book now before us has a twenty-page introduction, which may be necessary, but which probably should be relegated to the fine-print glossary at the end of the text. Then follow about twenty pages of keys, which should enable the merest tyro to "run down" the plants he may have in hand. These we have not tested, but no doubt they will prove usable. No one can make keys that are not now and then misleading, and no doubt now and then the student will get "off the track," but in such event he will simply have to try again until he succeeds in reaching his destination—the name and description of the unknown shrub.

The manuscript of this book was left practically complete by its author at his death, and it was prepared for publication by his daughter and Professor Harshberger. The book should merit an early new edition, and when that is made the nomenclature and the recognition and sequence of families should be modernized. The Benthamian sequence is quite too much out of date for a book of this kind.

AN IMPORTANT EXPERIMENT

"EXPERIMENT Station Work with Special Reference to the Streamflow Study" is the title of a paper recently presented by Mr. C. G. Bates before the Society of American Foresters at Washington. After briefly reviewing the work of the Coconino Forest Experiment Station in Arizona and of the Fremont and Wagon Wheel Gap Stations in Colorado, Mr. Bates described in detail the methods and equipment to be used in the streamflow experiment now under way at the last-named station. This experiment, which is being carried on jointly by the Forest Service and the Weather Bureau, involves the measurement for a number of years of two streams flowing out of forested watersheds, and, later, a comparison of the flow of these streams after the forest cover has been removed from one of the watersheds. Dams, weirs and recording instruments for measuring the flow of the streams have been installed as well as instruments for measuring the various atmospheric factors which may affect the flow. No point has been neglected in making this experiment as conclusive as possible. By means of the two periods of comparison between the two streams the importance of all outside factors is practically eliminated.

This experiment, which has been preceded by but one of a similar nature in Switzerland, is in reality much more comprehensive than any yet undertaken and should throw a good deal of light on the much-mooted question of the relation of forests on mountain watersheds to the flow of the mountain streams and to their usefulness for irrigation.

PLANT GENERA

QUITE recently the Leipzig publisher, Weigel, brought out a most useful book, "Die Pflanzengattungen," by J. C. T. Uphof, of Amsterdam, who signs himself as "Botaniker und Gartenbautechniker." It gives the approved name, geographical distribution, num-

ber of species and the relationship of every genus of vascular plants ("Phanerogamen und Pteridophyten"). Whether the remainder of the vegetable kingdom is to be covered in this manner by the author is not stated, but we may here express the hope that this will be done.

By leaving out synonyms, and by printing two columns on each page the author and publisher are able to bring the whole book into 260 pages, including a four-page "Übersicht der Familien" and a three-column, sixteen-page index. The sequence of families is essentially that of Engler and Prantl, *reversed,* and the older ideas as to the limits of families are generally adopted. Thus we find *Compositae* undivided, as also *Convolvulaceae, Ericaceae, Rosaceae* and *Cupuliferae,* while on the other hand we have *Leguminosae* divided into *Mimosaceae, Caesalpiniaceae* and *Papilionaceae,* and *Sapindaceae,* into *Sapindaceae,* proper, *Hippocastanaceae* and *Aceraceae.* The number of species is given for each genus, tribe, family, series, class and phylum, and for the larger groups the numbers of genera and families are given. We know of no other work in which numerical relations have been so fully worked out as in this little book. Incidentally we find in these latest estimates that the number of known species of plants[1] is considerably larger than has been supposed, and we have the data for making the following changes in the table as given on the pages cited:

Pteridophyta	3,820	species	instead of	2,500
Calamophyta	24	"	"	20
Lepidophyta	701	"	"	900
Cycadophyta	137	"	"	140
Strobilophyta ...	386	"	"	450
Anthophyta	132,584	"	"	110,000

The latter are divided into: Monocotyledons, 23,747 species instead of "about 20,000," and Dicotyledons 108,837 instead of "about 90,000." These corrections bring the total number of species of plants now known up to somewhat more than 233,000 (instead of 210,000).

CHARLES E. BESSEY

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[1] See SCIENCE for November 11, 1910, pp. 669–670.

SOCIETIES AND ACADEMIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

THE 684th meeting of the society was held on November 19, 1910, Vice-president Rosa in the chair. Three papers were read:

Record of Lightning Stroke at Cheltenham Observatory: R. L. FARIS, of the Coast and Geodetic Survey.

This paper gave a description of the occurrence of a lightning discharge which struck the Cheltenham magnetic observatory during the prevalence of a severe thunder-storm on the evening of July 12, 1910, and the effect it produced upon the self-recording magnetic instruments. Lantern slides of the photo-magnetic records during the thunderstorm were exhibited, and tables of base-line values for periods of time before and after the occurrence of the disturbance which showed that no permanent displacement of the magnets had been produced by the electrical discharges. (This paper will appear in full in the *Journal of Terrestrial Magnetism* for December, 1910.)

Recent Work on the Selective Emission of the Welsbach Mantle and the Acetylene Flame: Dr. W. W. COBLENTZ, of the Bureau of Standards.

The speaker described experiments on the emission and the absorption of the acetylene flame. The results obtained show that, within the limits of experimental error, in the visible spectrum the emissivity is a simple function of the thickness of the radiating layer of the flame, while in the infra-red the emissivity is a more complex function of the thickness. The acetylene flame has an absorption band at $.6\,\mu$, with regions of greater transparency in the violet and in the red. No emission band exists at $.7\,\mu$, as was previously supposed. The conclusion reached is that the radiation from the acetylene flame is purely thermal, and that it is not necessary to introduce the question of luminescence to explain the observations.

Experiments were also described on the radiation from the Welsbach mantle and from the same material used as a solid rod. The spectral energy curves of these two forms of radiators of the same material are entirely different, due to the difference in the thickness of the radiating layer. Cerium oxide changes its pigment color

with rise in temperature, due to a broadening of the absorption band in the violet. This rapid broadening of the absorption band into the visible spectrum makes the cerium oxide a more efficient radiator of light than it would be if it did not have this property. The conclusion reached was that the radiation from the gas mantle is a thermal phenomenon, not requiring the introduction of catalytic action to explain the observations.

Some Bugbears in Calorimetry: Dr. W. P. WHITE, of the Geophysical Laboratory of the Carnegie Institution of Washington.

The speaker briefly mentioned the fundamental principles upon which the accuracy in calorimetry depends, and stated that during the last four years the accuracy had increased tenfold. The principal bugbear in calorimetry is the cooling correction. This correction was discussed at some length and the things heretofore considered essential in connection therewith were mentioned. By taking advantage of these the cooling correction is easily handled. The lag, and the error due to it, were then discussed, this question being investigated here in Washington for the first time and with the result that there is now no error left due to this cause.

In speaking of the error in the measurement of the temperature (now the only real error remaining) the different kinds of thermometers that had been employed were mentioned. Different types of calorimeters were described and one form was exhibited for inspection. Diagrams were shown giving some results in which the errors due to the cooling correction were negligible. The final accuracy was 1/10,000 part.

R. L. FARIS,
Secretary

THE 685th meeting of the society was held on December 3, 1910, Vice-president Day in the chair. Two papers were read:

Explosions in Gaseous Mixtures: Mr. L. H. ADAMS (by invitation), of the Geophysical Laboratory of the Carnegie Institution of Washington.

The speaker described certain conditions under which explosions in gaseous mixtures take place, and spoke of the retarding effects of inert gases on the explosion. Explosion is a reaction which proceeds with increased velocity, and is accompanied by a rise of temperature, the ignition point depending on the heat capacity. Causes of mine explosions were briefly discussed, the speaker also pointing out that it would be of great value to be able to predict the explosive conditions of the air in mines.

Explosive experiments with methane mixed with air and carbon dioxide were described and the conditions of explosion explained, and the per cent. of methane defining the upper and lower limits of explosion were given, this being also illustrated by a diagram. In studying how inert gases retard explosion, the explosion wave had been looked into.

The Melting and Boiling Points of some of the Chemical Elements: Dr. G. K. BURGESS, of the Bureau of Standards.

The status of our present knowledge of the best values to assign to the melting and boiling points of the elements was illustrated by means of a diagram representing their periodic distribution in terms of atomic weights, and on which was also indicated graphically, in the case of the melting points, the outstanding uncertainty of each of these temperatures.

The several optical methods used for determining the higher temperatures were described and their relative merits compared, and the results of some of the recent investigations were discussed in some detail.

The availability, reliability and reproducibility of the various melting and boiling temperatures of the elements which are used as fixed points, or standard temperatures in thermometry, were also discussed.

Finally, after showing that the most probable value on the constant volume gas scale of the sulphur boiling point is $444^\circ.70 \pm 0^\circ.08$ from all of the available data, there was given a description of the behavior of boiling sulphur, the method and apparatus employed for realizing a constant temperature in its vapor, including also an account of the explorations of the temperature distribution within the 30 cm. column of sulphur vapor, and within radiation shield, of the usual form of S.B.P. apparatus.[1] Use was made of various types of thermo-electric and resistance thermometers, the smallest of the latter being 9 mm. in length and of $13.1\,\omega$ resistance in sulphur, capable of being read accurately to $0^\circ.01$ C. The sulphur vapor was found to be of a temperature constant to $0^\circ.03$ C. throughout 27 cm. of

[1] See Waidner and Burgess, Bull. Bureau of Standards, 6, pp. 149–230, 1910.

its length. The discrepancies heretofore found with thermo-couples were shown to be avoidable when suitable precautions are taken. The sulphur boiling point, therefore, under readily realizable and reproducible experimental conditions, appears to be the best defined and most reproducible of all the fixed points, melting or boiling temperatures, furnished hitherto by any of the chemical elements.

R. L. Faris,
Secretary

THE AMERICAN CHEMICAL SOCIETY
NEW YORK SECTION

The third regular meeting of the session of 1910–11 was held at the Chemists' Club on December 9 in conjunction with the American Institute of Chemical Engineers, who were holding a general meeting in New York at the time.

The evening was devoted to a symposium on sewage disposal, in which the following addresses were made:

"The Principles of Sewage Disposal," Geo. C. Whipple.

"Sewage Disposal in Europe," Rudolph Hering.

"Sewage Disposal in New York and Vicinity," Geo. A. Soper.

"Sanitary Conditions in their Relation to the Water Supplies in the Vicinity of New York," Nicholas S. Hill, Jr.

"The Unsolved Problems of Sewage Disposal," Chas. E.-A. Winslow.

C. M. Joyce,
Secretary

THE BOTANICAL SOCIETY OF WASHINGTON

The 10th annual business meeting of the society was held on Saturday, November 12, 1910. Officers were elected as follows: *President*, W. J. Spillman; *Vice-president*, R. H. True; *Recording Secretary*, W. A. Orton; *Corresponding Secretary*, W. W. Stockberger; *Treasurer*, F. L. Lewton. The executive committee announced an active membership of ninety, there having been fourteen accessions during the year.

The 67th regular meeting of the society was held at the Cosmos Club on Friday, December 2, 1910, at eight o'clock P.M., with President Spillman in the chair. Thirty-nine members were present. Dr. C. F. Clark, W. W. Eggleston, Paul Standley and G. T. Harrington were admitted to membership.

The following papers were read:

Effect of Variation in Light on Sugar Production in Beets: H. B. Shaw.

Identical strains of high-grade sugar beets were observed to yield widely varying percentages of sugar in different localities. Variations in methods of cultivation, fertilization and in soil do not appear sufficient to account for this. Therefore experiments were carried on to determine the influence of variation in the intensity of sunlight.

During 1909 and 1910 sugar beets in the open field in Utah were treated as follows: a portion of a long row was left under ordinary field conditions, a portion of the same row was shaded with one thickness of white bunting, another part with two-fold bunting and the remainder of the row with three-fold bunting, during the entire season.

The more striking results are tabulated below:

Relative Light Intensities

(Based on the actual duration of bright sunshine and diffused light for the entire season.)

	Shade	Open row	Single bunting	2-fold bunting	3-fold bunting
		100	32.2	16.7	9.7
Relative Temperatures					
	82°F.	112°F.	100°F.	96°F.	94°F.
Analyses of the Beets					
Weight (av.) in oz.		27.76	11.08	3.84	1.75
Total sugar in beet (oz.)		3.80	1.33	0.32	0.15
Average per cent. sugar in beet		13.70	12.00	8.30	6.00
Purity		76.70	81.00	66.00	61.00
Relative proportion of sugar		25.33	8.86	2.10	1.00

Smelter Injury to Forests: Dr. Geo. G. Hedgcock.

The full paper will be published later as a Bulletin of the Bureau of Plant Industry.

Cultivation of Tobacco in Cuba: Dr. H. Hasselbring.

In this paper, which was illustrated by photographs, the general methods practised in tobacco culture were described. The peculiar methods of obtaining seed and handling seedlings were emphasized. Seed is collected from suckers and is usually sent to the mountains where the seedlings are grown in fresh soil. At planting time the seedlings are packed in bales and shipped to the various parts of the island where they are needed and frequently many days elapse before they are set in the fields.

W. W. Stockberger,
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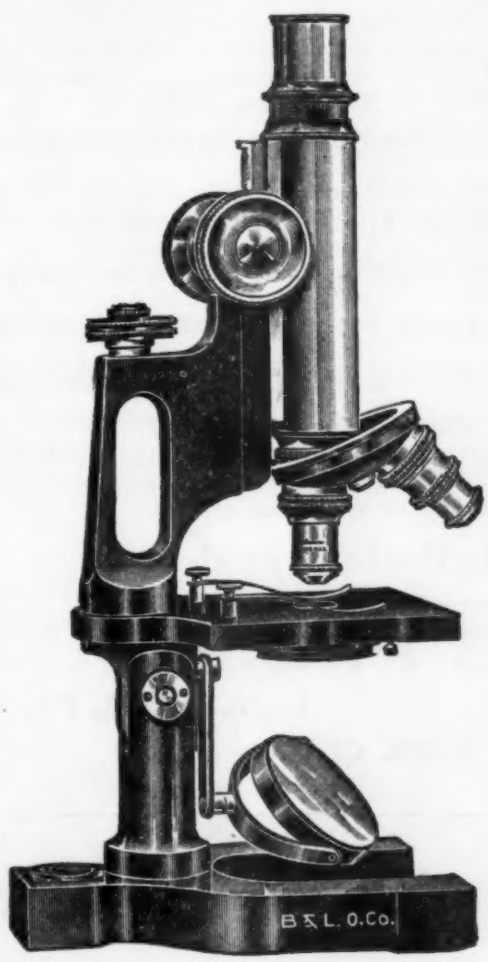

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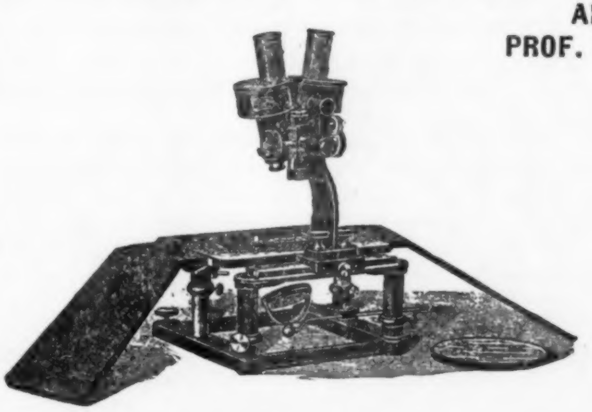

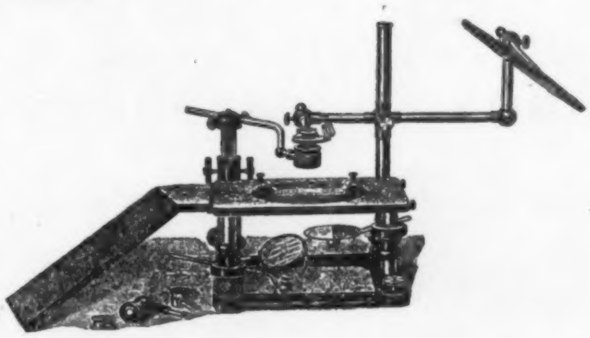

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